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THE EFFECT OF BRANCHING AND PRIOR FAMILIARITY ON
ACHIEVEMENT, COMPLETION TIME, AND LEARNER ATTITUDE

City University of New York

PH.D.

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THE EFFECT OF BRANCHING AND PRIOR FAMILIARITY
ON ACHIEVEMENT, COMPLETION TIME,
AND LEARNER ATTITUDE

by

CHARLES AUSTEN DYER

A dissertation submitted to the Graduate
Faculty in Education in partial fulfillment
of the requirements for the degree of
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1980

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This manuscript has been read and accepted for the Graduate Faculty in Education in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

This study compared branching (forward skipping) and non-branching (linear) instructional treatments using a design which allowed for possible aptitude-treatment interactions (ATIs) between students' prior familiarity and the type of treatment. Level of prior familiarity was hypothesized to interact with treatment so that students who were prefamiliarized would take less time for the branching treatment than for the linear treatment, while students who were not prefamiliarized would take the same time for linear and branching treatments. For prefamiliarized students, achievement from the linear treatment would be lower than from the branching treatment, while students who were not prefamiliarized were expected to achieve about the same whether they were given the linear or the branching treatment. Prefamiliarized students were expected to make fewer errors on the instructional program than those who were not prefamiliarized. For the linear treatment, those who were prefamiliarized were expected to have less positive attitudes toward the instruction than those who were not prefamiliarized.

Three versions of a computer-assisted instruction (CAI) program were given to 120 subjects (36 males and 84 females) who were randomly divided into three equal groups. One half of each group was prefamiliarized with the content of the lessons, while the other half was not prefamiliarized. One group used a linear (no skipping) version of the program; the second group used a version of the program which employed forward skipping; and the

third group was a yoked control for the second group. A posttest and an attitude measure were administered when the instructional program was completed.

Posttest scores and the data gathered by the program were analyzed using a 2 X 3 ANOVA. Although prefamiliarization resulted in significant branching, the hypothesized interactions were not found. The prefamiliarized groups achieved consistently better, and the branching groups took less time for the instruction. In addition, the yoked unfamiliarized group did consistently better than expected. The absence of the expected interactions appeared to be due to a combination of subjects' comparatively poor retention of the lesson material, a low level of instructional support for the unfamiliarized groups, and feedback provided by the posttest. The instructional support provided by the forward skipping strategy furthermore tended to provide more differentiation at the top of the achievement scale and less at the bottom, which hindered the detection of interactions.

Further investigation seems warranted using both a more complex forward skipping strategy (so as to permit better differentiation between unfamiliarized groups) and with posttest feedback eliminated. Further investigation of the performance of the yoked unfamiliarized group also seems warranted.

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Charles A. Dyer

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CHAPTER I

INTRODUCTION

This paper deals with the design of adaptive instruction. Adaptive instruction is presumably more effective and more efficient than non-adaptive instruction for any population of learners since those methods and materials which yield the highest achievement for each individual will be used.

Adaptation (whether in terms of teaching method, materials, or environment, for instance) can be described as a choice between alternatives, and can thus be thought of formally as branching. What is branching? Branching involves a decision, typically about the content, sequence, or mode of presentation of instruction, and the execution or application of one of several instructional alternatives. Branching is characterized by a decision which results in the execution of one of several alternative actions. Branching decisions can be reduced to a binary--"yes" or "no"--form involving choices between two alternatives at a time.

The basis for making branching decisions is similar to making decisions about statistical significance. A "critical value" or pass level of some variable is chosen, usually based on past experience and the needs of the situation. When this critical value is met, the criterion in question has been satisfied. When the critical value is not met, the criterion has not been

satisfied. In either case, one of the alternative actions associated with the decision can then be executed. Extremely complex adaptive paradigms can be created using combinations of this simple branching form.

What are the criterion variables on whose values adaptive decisions should be based? How should critical values be established? When can critical values be established and what dictates when they should be modified? Are these variables related to instructional method, to learner characteristics, or both? Do they depend on the subject matter to be learned, or not? The research outlined here is intended to establish empirically whether branching adaptation in instruction actually does contribute to learners' increased achievement, and to investigate the conditions which facilitate this increased achievement. An examination of the research on branching and an analysis of the possible aptitude-treatment interactions (ATIs) which may be involved in a comparison of branching treatments yields the conclusion that while adaptive branching may be the "best possible" treatment for many learners, other treatments may be as effective or perhaps even better than a branching treatment for learners with different characteristics.

Adaptive branching is a specific kind of instructional support (Tobias, 1976). Other forms of instructional support include logical item sequence, overt responding, and explicit feedback during instruction. Instructional support is a relative term. It generally implies that something has been added to the

instruction in question to meet the needs of some specific class of learners so that their learning is facilitated. An interaction between adaptive branching (as a specific instance of instructional support) and learners' prior familiarity with the subject matter if empirically established will be useful for determining when branching in instruction is practical and necessary.

The construct of prior familiarity in interaction with instructional support represents a first attempt at a theoretical stance to describe ATI findings systematically. Empirical verification of this construct offers the possibility of a guiding generalization to organize this body of work.

CHAPTER II

REVIEW OF THE LITERATURE

Studies relevant to the proposed research can be categorized as studies dealing with aptitude-treatment interaction, comparisons of linear versus branching strategies, comparisons of logical versus random sequence, and studies dealing with learner-controlled instruction.

Aptitude-Treatment Interaction (ATI)

Aptitude-Treatment Interaction (ATI) or Attribute-Treatment Interaction (Tobias, 1973) is the general term which describes the relationship between any instructional treatment in interaction with any variable on which people differ. The results of research in this area can be used to adapt instruction to differences which exist between individual learners.

Cronbach, in an address to the American Psychological Association Annual Convention in 1957, first outlined the conceptual basis for the current interest in ATIs as an approach to individualization of instruction (Cronbach, 1957). Presented as a reconciliation of the experimental and correlational approaches to the investigation of learning, this approach in ideal form takes advantage of a disordinal interaction between treatment and aptitude to identify a "best possible" treatment for any given aptitude level. Useful summaries of the research and discussions

of important concepts, research issues, and techniques in research on ATI, have been compiled by Salomon (1972), Bracht (1970), Cronbach (1975), Cronbach and Snow (1969,1977), Berliner and Cahen (1973), and Tobias (1973a,b, 1976, note 15, note 17). Studies involving ATI have included all forms of instruction, from conventional classroom instruction delivered by a teacher to a group of pupils, to programmed instruction on cards or in book form or delivered via teaching machines, to computer-based instruction generated, delivered and scored by the computer.

Definitions

What is an aptitude? Cronbach and Snow (1969) define an aptitude as "any characteristic of the individual that increases (or impairs) his probability of success in a given treatment." (p.7) By this definition, anxiety scales, IQ tests, performance or personality measures of various kinds would be measures of aptitude. These indirect measures are assumed to be indicators of the internal states we are interested in. The usefulness of these indicators of course must be established empirically. That is, the assumption that internal state and external phenomenon are systematically related--at least over some useful range--must be tested by observation.

What is a treatment? The term "treatment" includes any procedure or environmental factor which is part of instruction. Treatments can vary in terms of "the characteristics and dimensions of the instructional agent or medium of interaction; the

content to be learned; and the environment in which the instruction takes place" (Berliner & Cahen, 1973, p. 59).

As Cronbach and Snow mention, the commonest variations in instruction involve "variations in the pace or style of instruction" (p. 7). In the broadest terms possible, a treatment consists of everything which takes place between pretest and posttest. A treatment may consist of one or more tasks of various kinds, may use various presentation methods or various kinds of materials, and may involve many other adaptations of the learning environment.

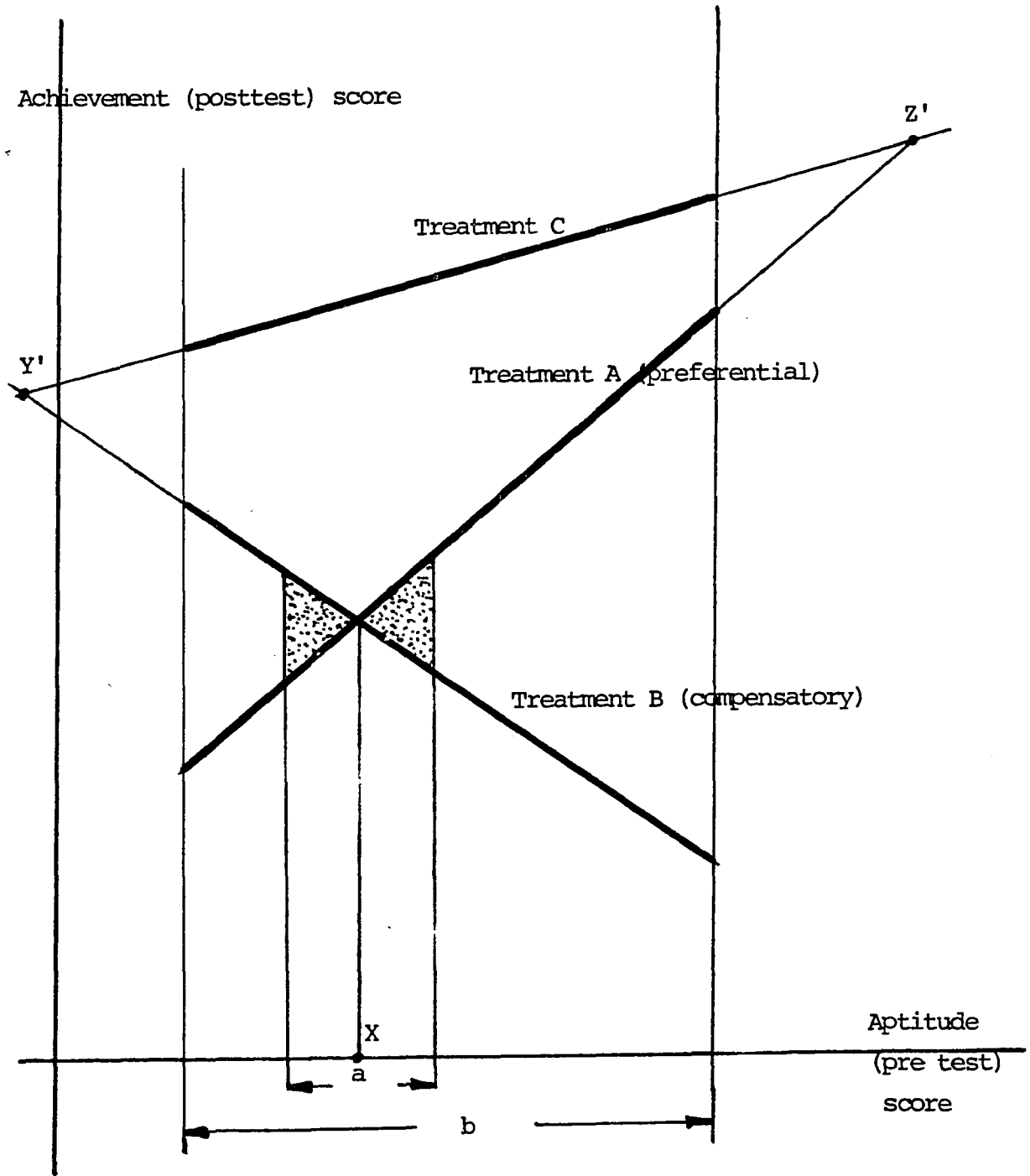
Types of Interactions. The concept of ATI can be visualized in terms of regression lines or cell means from an analysis of variance involving an interaction. Figure 1 shows a typical ATI depicting achievement (posttest) scores on some learning task at high and low levels of aptitude (pretest) score for two instructional treatments, A and B. The crossing of lines A and B indicates a disordinal interaction. This means that the treatment used with any individual learner can be varied so as to maximize achievement across aptitude levels. Since learners with high aptitude achieve more with treatment A while learners with low aptitude achieve more with treatment B then, ideally, learners with aptitude scores below value X should receive treatment B and those with aptitude scores above X should receive treatment A.

In Salomon's terms (Salomon, 1972), the negative slope of treatment B in Figure 1 characterizes treatment B as a

compensatory treatment or instructional strategy compared to preferential treatment A, which has a positive slope. Treatment A capitalizes on what the high aptitude learner does well; treatment B avoids what the low aptitude learner doesn't do well. A treatment line with a positive slope implies that the higher a subject's aptitude, the better achievement this treatment will yield. A negative slope implies that while this treatment provides those with lower aptitude with what they need to achieve more, this help adversely affects the achievement of those subjects with higher aptitude. A disordinal interaction involving a positive and a negative slope implies a useful range of activity for the widest possible range of aptitudes.

What determines the critical level at which one treatment should be replaced by another treatment? The ideal maximal treatment for a given aptitude is shown by the top part of the disordinal interaction shown in Figure 1. Aptitude value X is the theoretical point at which either treatment A or treatment B should yield the same level of achievement. At this point, other factors such as time for completion or cost to produce and administer instruction may determine which treatment is preferable. In terms of empirical measurement, point X is actually a region a on the aptitude scale where no significant difference can be found between achievement scores for either treatment. The Johnson-Neyman technique (Johnson & Neyman, 1936; Cahen & Linn, 1971; Berliner, note 2) is one useful means for identifying this region. As a approaches the entire range of aptitudes in

Figure 1
Aptitude-Treatment Interaction



magnitude, a single treatment is more justified for all aptitude levels because there will be a larger proportion of cases where no significant difference in achievement will result from using either treatment A or treatment B. As a decreases to zero, on the other hand, there is generally more justification for the existence of two treatments because they will yield significant differences in achievement in a larger proportion of cases.

Treatments A and C represent an ordinal interaction, where an interaction exists, but the treatment lines do not cross, so that one treatment yields higher achievement than the other for both high and low aptitudes. Ordinal interactions also may involve compensatory or preferential treatments. One treatment, however, always yields higher achievement so that no advantage can be obtained by using the other treatment with either extreme of aptitude.

Ordinal interactions, of course, imply that the treatment lines involved do meet somewhere. This means that a disordinal interaction may possibly be observed if the measuring instrument or procedures used can be modified so that in effect the aptitude scale is extended to the right or left, as shown for treatment C and treatment B (point Y') and for treatment C (point Z') and treatment A in Figure 1.

When ATIs are used as the basis for instructional decision-making, aptitude is a predictor for achievement and is the comparison variable for decisions about which treatments are more effective. Aptitude is measured by a pretest score. When a

disordinal interaction exists, the critical value of this variable for instructional decision-making can be determined by identifying the point corresponding to point X in Figure 1. When an ordinal interaction exists, the critical value is effectively at one extreme or another of the observed range of aptitudes so that one treatment is always used.

Representative ATI Studies

Tallmadge and Shearer (1971) investigated the influence of inductive versus deductive teaching methods and meaningful versus rote approaches to learning on achievement. Six experimental courses were given to a total of 353 Navy enlisted men. Four of the courses, in Celestial Navigation, involved (a) meaningful learning of a deductive presentation, (b) meaningful learning of an inductive presentation, (c) rote learning of a deductive presentation, or (d) rote learning of an inductive presentation, where the Celestial Navigation subject matter was based on meaningful rules.

Two of the courses, in Aircraft Recognition, involved (a) rote learning of a deductive presentation, or (b) rote learning of an inductive presentation, where the Aircraft Recognition subject matter was based on arbitrary rules.

One-day classroom presentations were given to a random sequence of 30-man groups. Thirty-nine other measures were also available for each subject. Criterion tests were administered to each group immediately after the instruction.

No significant difference was found between modes of instruction or learner characteristics. A significant interaction was found between inductive/deductive mode of presentation and subject anxiety. High anxiety subjects did better on the criterion tests when given an inductive presentation; low anxiety subjects did better when given a deductive presentation.

Salomon (1974) hypothesized that visual transformations learned from watching various film techniques could be internalized and applied to subjects' problem solving in other contexts. Eighty eighth grade students were randomly assigned to four groups of equal size. A modeling group was explicitly shown three examples of a "zooming" technique applied to a painting so as to bring out a specific detail then show it in context again. A short-circuiting group was shown an approximation of the "zooming" technique, where the beginning and ending states were shown using slides, but the intermediate transitions were omitted. An activation group was simply shown the painting. A control group received none of these treatments. Each treatment group was shown three paintings, and were asked to write down 80 details they had noticed in each of the paintings. A timed pretest and a timed posttest of cue attendance were also administered.

The three treatment groups noticed significantly more on the posttest than did the control group. The posttest performance of both the modeling and the activation group were better than the short-circuiting group, and the former two groups were not significantly different from each other. A significant

interaction was found between pretest cue-attendance aptitude and the modeling and activation treatments.

A second experiment tested the hypothesis that labeling or verbalization would improve posttest performance. Fifty-six eighth-grade subjects were randomly assigned to four equal-sized groups: Modeling-verbalization, Modeling-nonverbalization, Activation-verbalization, Activation-nonverbalization. The stimulus conditions were otherwise identical to the modeling and activation conditions used in the previous experiment. A cue attendance pre- and posttest, as well as an Embedded Figures Test, a measure of spatial organization, and a test of verbal ability were used. No significant difference was found between the modeling treatment and the activation treatment, and no significant difference was found between the verbalization and no-verbalization treatments. An interaction was found such that for the nonverbalization treatment, subjects with the modeling condition and with low cue-attendance pretest scores had significantly higher cue-attendance posttest scores than subjects with the activation condition and low pretest scores. On the other hand, the activation condition with no verbalization yielded better cue-attending posttest scores for those with high cue-attendance pretest scores. For the verbalization treatment, this kind of interaction did not occur. For the no-verbalization treatment, as verbal ability decreased, cue-attendance posttest scores increased; as verbal ability increased, cue-attendance scores decreased.

In a third experiment, it was hypothesized that verbally oriented subjects would acquire the operations presented, but would deal with them internally as verbal operations, not visual operations. Forty-two male ninth-grade vocational-school students were randomly assigned to a modeling, a short-circuiting, or a control group in equal numbers. The modeling group was shown a film where five solid objects were each laid out, step by step, to give a flat "unfolded" version of the object, then each folded back up to give the original solid object. The short-circuiting group was shown five pairs of slides, each pair showing a solid object and the corresponding flat "layout." The control group received no film or slide presentation. All three groups were given a pretest and a posttest. The two treatment groups were given a general introduction, then were shown their respective presentations three times, once on each of three consecutive days. Subjects' average grades in language studies and in mathematics were also obtained.

An interaction was found between type of treatment and subjects' verbal aptitude, where the modeling treatment yielded higher posttest scores for subjects with low language scores, but lower posttest scores for those with high language scores. In contrast, the control group had low posttest scores for those with low language scores, and high posttest scores for those with high language scores. The short circuiting treatment yielded essentially the same posttest scores for all language scores.

Trown and Leith (1975) investigated ATI using a

"supportive" and an "exploratory" teaching strategy, with each strategy implemented using one of five models, to teach 432 grade-school children material on directed integers. All subjects were tested using a non-verbal test of mathematical ability and a test of anxiety and extroversion. A control group of 112 children were given all the tests but received no instruction. A constructed-response pretest and an identical criterion posttest were administered and unadjusted gain scores were used as a measure of retained learning. Treatments were administered in random order in each school to groups of no more than ten children at a time. The "supportive" strategy was deductively organized. It included a statement by the teacher of the principle involved in the material to be learned, some activity by the students working with the model, and a restatement of the principle by the teacher. The "exploratory" strategy was inductively organized. It involved the same student activity with the model but no preliminary statement of principle by the teacher. The students initially had the opportunity to discover the principle for themselves.

No significant differences in gain scores were found for type of model or for strategy, but higher ability level led to significantly higher gain scores and the non-anxious subjects scored significantly better than the anxious subjects. A significant strategy by anxiety interaction was also found. While the supportive strategy yielded about the same gain scores at high or low anxiety levels, the exploratory strategy yielded

much higher scores for low-anxiety subjects and much lower scores for high-anxiety subjects. This was contradictory to the findings of Tallmadge & Shearer (1971).

Ott and Macklin (1975) investigated ATI in a freshman physics course, where 575 engineering and physics majors took either a "standard" version or an audio-tutorial version of the same course content, and had the same homework, examinations, and similar laboratory assignments. One group of students was assigned to treatments on the basis of personal preference and their individual schedules; a second group was assigned randomly to one of the two treatments.

The standard version of the course consisted of two hours of lecture and two hours of small-group recitation a week, and a two-hour lab every other week. The audio-tutorial version included an hour of small-group recitation each week plus individual sessions at the students' convenience in a learning center staffed by tutors. The learning center contained laboratory equipment, audio-tape materials and slides to be used in conjunction with a study guide. Pretest scores were obtained for math aptitude, verbal aptitude, and math achievement.

Course grade (based on grades for lab reports, quizzes, and exams) was used as the measure of achievement. An interaction was found between math aptitude and achievement and method of instruction so that the "standard" treatment yielded higher achievement for high-aptitude high-pretest students, while the

audio-tutorial treatment yielded higher achievement for low-aptitude low-pretest students.

Ott (1976) investigated the effects of method of instruction and assignment procedure on student achievement and attitudes. About 550 freshman engineering and physics majors in a freshman level physics course were assigned to a "standard" or an "auto-tutorial" (AT) version of the course either on the basis of personal preference or random assignment. Both versions of the course used the same textbook and course notes, covered the same content, and were given the same homework and laboratory assignments. They were also given the same quizzes and examinations. The "standard" course consisted of two hours of lecture and two hours of recitation a week. A two-hour laboratory was scheduled every other week. The AT course involved one hour of recitation a week, and all other instruction took place at the students' discretion and convenience in a learning center where materials and tutors were available.

Students' final grades in the course were used as a measure of achievement. SAT Math scores were obtained for the subjects, and a course-specific pretest was also used. For students assigned by preference, there was a significant interaction, where those who selected the "standard" course achieved better grades than those who selected the AT course. The "standard" course yielded consistently higher grades than the AT course. For randomly assigned students, math achievement was

significantly related to course grade. No interaction between math aptitude and grade was found.

Summary of ATI Research

The literature on ATI research presently includes a very large number of studies on various aspects of Attribute-Treatment Interaction. Though they cover a wide range of attributes and treatments, most of these studies are organized along the same general lines. "The typical ATI study is a two-group experiment. The measure of outcome is regressed onto a score recorded prior to treatment. If the regression lines in the two treatments differ in slope, that is evidence of Aptitude X Treatment interaction" (Cronbach, 1975, p. 116).

Although the concept of ATI and the means by which it can be measured are easily understood, and although the application of such findings to educational practice seems like a simple, straightforward matter, some unresolved problems must be dealt with before this approach can be put to widespread use. The performance and the aptitudes under consideration in ATI studies involve complex relationships between many variables. No means has yet been established for determining when an observed interaction in one setting can be generalized reliably to other cases, or even what makes one set of circumstances in instruction different from another. Further, while three- or four-way or even higher order interactions between variables often exist, these interactions are at present neither evidenced effectively nor

interpreted meaningfully, as is shown by the number of studies which are unreplicable or have yielded non-significant findings. The usefulness of an ATI approach has been limited by the tools available for dealing with multivariate relationships which are conceptually quite complex.

Trown and Leith's (1975) investigation of the interaction between pupil anxiety and supportive or exploratory treatments, and the studies by Ott & Macklin (1975), and Ott (1976), where an interaction was observed between method of assignment to a physics course and audio-tutorial or "standard" method of instruction are fairly typical examples of research whose ATI approach is valuable in curriculum development applications. In many instances, however, the problem of identifying significant variables and the potential complexity of the interactions between variables tend to limit the range of application of an ATI approach. The findings of Tallmadge (1968) and Tallmadge and Shearer (1969, 1971) illustrate this problem. While the first study yielded no significant interactions between type of treatment and learner attributes or learning style, the later investigations showed an interaction when subject matter was also taken into consideration.

How can subject matter considerations contribute to a useful conceptualization of ATIs? Berliner and Cahen (1973) stress the importance of the task-specific (i.e., subject matter oriented) nature of ATIs, and indeed go so far as to suggest that they be dealt with as Trait-Treatment-Task Interactions.

Tobias (1976) also suggests that attribute-treatment interactions may be subject-matter specific. Salomon's (1974) findings that subjects' level of prior acquaintance with the subject matter (in this case a visual transformation operation) interacted with the degree to which the transformation had to be explicitly presented; and Tobias's (1973b) observation of an interaction between level of prior familiarity and logical or scrambled item presentation provide useful insight into how subject matter considerations may provide an organizing concept for the investigation of ATIs: The evidence indicates that attribute-treatment interactions depend not only on what subject matter is involved, but on how much of it learners are acquainted with.

Branching

Branching involves decisions about the sequence or format in which subject-matter content will be presented. These decisions are typically based on test items--for instance, questions embedded in a program. Other measures might also be used as the basis for branching decisions. For instance, environmental or grouping factors, or information derived from the subject content being presented could be used.

Ways of Analyzing Branching

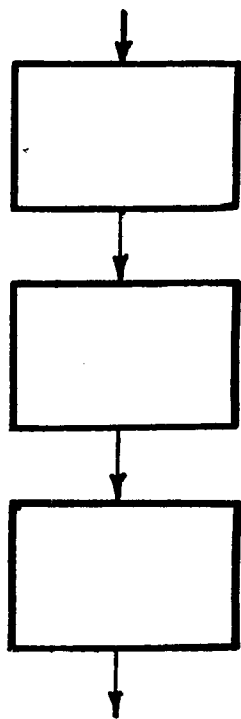
Many kinds of adaptive branching strategies are possible. Bohm and Jacopini (1966) established that all such strategies can be represented by combinations of the set of

three schemas shown in Figure 2. The diamond shaped decision or predicate boxes in Figure 2 represent branches made on the basis of the binary decision strategy previously described. The rectangular boxes represent an instructional procedure such as the presentation of subject matter content or criterion tests.

Figure 2a represents a linear strategy, where material is presented in a fixed sequence and everyone gets the same presentation. Figure 2b represents a backward branching or repetition strategy, where a presentation is repeated if the criterion test associated with it is not satisfied. Figure 2c is an alternate branching strategy. Figure 2d represents forward branching or skipping ahead, which is a special case of Figure 2c where one of the branching alternatives is to have no instruction.

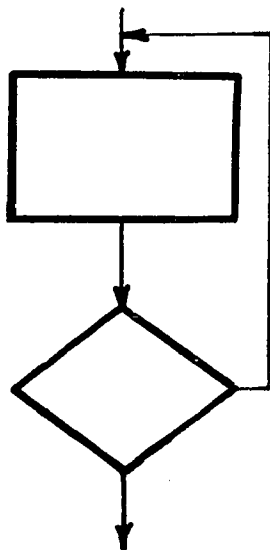
Two significant things should be emphasized about the representations in Figure 2. First, they can be treated as "black boxes," which can be nested repeatedly inside of each other to any desired depth. Any schema(s) can be nested inside any other schema, and the useful thing about the black box is that at any level of detail one need only be concerned with the input to a black box and the output which it yields. What happens inside the black box in terms of processing or flow of control (branching) is a logically separate issue. This is of course recognizable as simply a description of the principle of modular instruction. Secondly, all the branching strategies which might possibly be devised can be represented using combinations of these black box

Figure 2
Branching Strategies



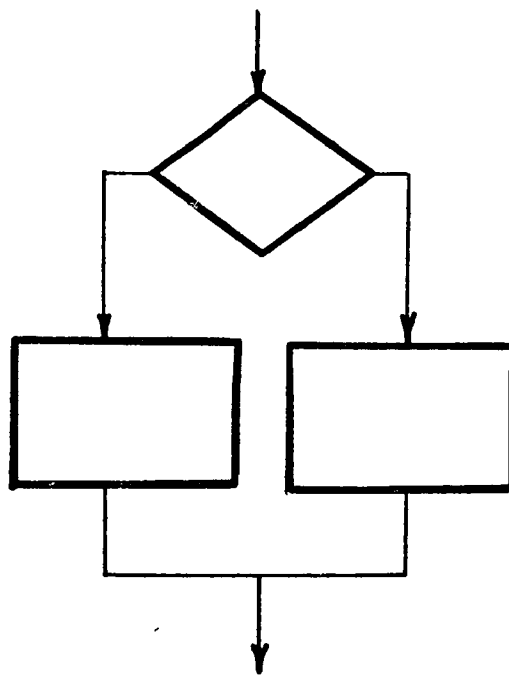
a

linear



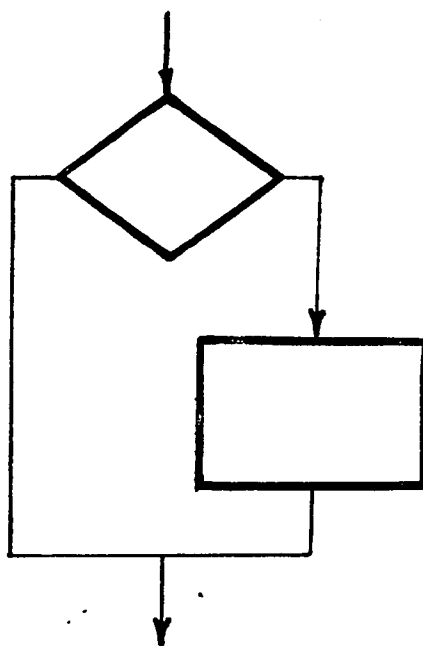
b

backward branching



c

alternate branching



d

forward skipping

schemas. Any instruction thus can be described using combinations of the constructs shown in Figure 2.

Any logical decision made in the course of instruction requires that a criterion variable be identified, a value for that variable be observed, and a critical value for that variable be established before that decision occurs. A procedure (represented by a process box) where these data are gathered must precede every decision (diamond-shaped box) somewhere in the instructional sequence. Exactly where this data-gathering procedure occurs for any given decision may however vary considerably.

Studies of Linear versus Branching Strategies

Holland (1975) analyzed adaptive decisions in programmed instruction in terms of the concepts of consequence ratio, predictive validity ratio, and discriminability ratio. Consequence ratio is the ratio of the time an instructional sequence takes to complete compared to the total time required to complete both the instructional sequence and a diagnostic test which permits the learner to branch around that instructional sequence. Predictive validity ratio is the ratio (given that the intervening instructional sequence in a program is removed) of the number of times a diagnostic test indicates an instructional sequence should be taken and the criterion test associated with it is failed, or a diagnostic test indicates instruction should be skipped and the criterion test is passed, compared to the total

number of such decisions made. Discriminability ratio is the ratio of the number of those who either passed or failed a diagnostic test, whichever is smaller, to the total number taking the diagnostic test. For instruction to be acceptably adaptive, Holland maintains that its consequence ratio should be .75 or better, its predictive validity ratio should be as close to 1.0 as possible, but at least .90, and its discriminability ratio should be as close to the maximum of .50 as possible.

Data were gathered from seven examples of adaptive materials to demonstrate the usefulness of these measures. These materials included a unit from the Job Corps Advanced General Education Program, Programmed Reviews of Mathematics (Flexer & Flexer, 1967), an IPI Math program (Lindvall & Bolvin, 1967), a unit from the Individualized Science Curriculum (Klopfer, Champagne, & Pittman, 1972), a program on inductive reasoning (Holland, Hoffman, & Doran, Note 6), a chapter from a TutorText program on The Arithmetic of Computers (Crowder, 1960), and a segment from a Stanford CAI Reading program (Atkinson, 1968).

None of the materials evaluated were acceptable on all three measures. Generally, the programs did not discriminate very well between subjects' knowledge of the subject matter, and in four of the seven cases predictive validity was poor. This led Holland to describe adaptivity as a myth, with no basis in fact and no data as yet generated to demonstrate that adaptation really does make a difference in learning. Apparently, most instruction is effectively non-adaptive. Very little instruction

is created with the systematic application of adaptive criteria in mind so that treatment is modified to account for aptitude.

Silberman, Melaragno, Coulson, and Estavan (1961) examined the effects of two methods of branching in two early experiments. In the first study, 51 high school students were divided into three groups of 17, each group being given a test of general mental ability then administered one version of a 61-frame program on logic. Three different presentation modes were used for the basic program: A fixed sequence of 5 X 8 cards, a back-branching sequence of 5 X 8 cards, or a textbook presentation based on the fixed sequence of cards. The fixed-sequence group received each frame once, with no repetition, and made multiple-choice responses to each item by thinking of the answer but not writing it. The back-branching group was allowed, but not required, to review previous items by backing up one item at a time. This group also made covert multiple-choice responses to the items in the teaching program. The textbook group did not have to make responses of any kind to the teaching material. The instructional program was rewritten in textbook form as statements incorporating the correct answers, and the students in this group were instructed to study the material however they wanted to.

Immediately after each training session, a posttest made up of 24 constructed-response and 24 multiple-choice questions was administered. Half of the questions resembled the training materials, and half of the questions required application to new

situations of the content which had been presented. The textbook presentation, which permitted students to branch or not to branch at their own option in any manner they chose, yielded significantly higher posttest scores than the fixed-sequence method. The hypothesis that the back-branching method would be superior to the fixed-sequence method because of its adaptive capacity was not confirmed. A significant positive correlation was found between aptitude pretest scores and criterion posttest scores for the textbook presentation. A significant negative correlation was found between aptitude pretest scores and training time for the fixed sequence presentation and not for the others.

In the second study conducted by Silberman, Melaragno, and Estavan, 36 high school students were randomly divided into two equal groups, given a test of general mental ability, and given a computer-controlled slide presentation made up of 411 multiple-choice items on logic. A "branching" group received material whose sequence was uniquely determined for each individual by the computer program on the basis of the errors made by that individual. A "fixed-sequence" group composed of individuals randomly paired with members of the "branching" group served as a yoked control. The sequence generated by the "branching" member of each pair was given to the yoked "fixed-sequence" subject. A posttest consisting of 51 multiple-choice and 44 constructed-response items was administered immediately after the training. Half of the items were similar to the

material presented during the training, and half of the items required application of what had been presented to new situations. No significant difference in posttest scores was found between the "branching" and the "fixed-sequence" presentations.

While this study found no significant difference between branching based on learners' errors and yoked presentations, it must be noted that the use of a yoked group implies that the branching items could not be keyed to specific responses made by the "branching" subjects. The yoked arrangement potentially limits the nature and extent of backward branching or remedial repetition. These limitations minimize much of the difference which might otherwise be manifested by the branching alternatives in the "branching based on errors" presentation. Within-treatment adaptation or remediation frequently seems to be not different enough in any significant respect from the mainline treatment (the "non-remedial" treatment) to which it is supposedly an alternative.

The first of these two studies, where subjects studied the textbook form of the program in any manner they wanted to, thus established "student option" as a better decision criterion variable than fixed sequence for maximizing achievement, but the second could not show that student error was a better basis for adaptive decision-making than fixed sequence.

Roe (1962) also found similar non-significant results when he compared forward branching with linear presentations. His subjects were 189 freshman engineering students who were

given a pretest in Mathematical Reasoning, ranked into three groups by aptitude, then randomly assigned from each third to obtain seven equal groups of 27 students. A 113-item program on elementary probability presented on index cards was used, each group being given one of seven presentations. A linear group worked through every item in the program. A forward branching group skipped ahead when they answered key items correctly. A backward branching group repeated sequences when they answered key items incorrectly. A backward alternate group used the same strategy as the backward branching group, but received different material instead of repeating the same items as before. A pre-test and forward branching group used the same strategy as the forward branching group, but took the criterion test given to everyone at the end both before and after the training. A random linear group used the linear strategy but were given items which had been randomly sequenced (i.e., scrambled). A textbook group was given the forward branching strategy, but the program was bound in textbook form instead of being a card file.

"Logical" sequence resulted in significantly higher achievement than "scrambled" sequence. Learning time for the forward branching strategies was significantly lower than for the backward branching strategies, but no significant difference in achievement scores was found between the two strategies. Simple forward branching yielded no time or achievement differences compared to linear presentation.

Campbell (1963) gave 780 public school students in three

equal groups three forms of a program on set theory. A "bypass" version of the program containing 15 basic segments and 15 corresponding remedial loops was given to one group. The remedial loops were only entered if the basic segments were not completed successfully. A second group received a short linear version of the program, consisting of just the 15 basic segments without the remedial loops. The third group received a long linear version of the program, consisting of the 15 basic segments and the 15 remedial loops presented in a linear fashion. Posttest achievement scores for the "bypass" group fell consistently between scores for the long linear and short linear groups. Significantly higher achievement scores were found for higher grade levels and higher ability levels. Amount learned and time spent on the program in any form corresponded closely to the number of program pages studied. Again, branching was not any more effective than linear sequencing.

Coulson, Estavan, Melaragno, and Silberman (1962) also investigated the basis on which branching decisions should be made. Two groups of 15 high school students were given two different versions of a 233-item computer-controlled program on logic. A "fixed-sequence" group was given all 233 items, with no variation in presentation for individual members of the group. A "branching" group was given individualized item sequences on the basis of three student response criteria: (a) number of errors over a group of items dealing with the same topic, (b) errors made in response to specific questions which indicated the

student had misunderstood the material, and (c) students' individual responses to items which asked whether they wanted to go ahead or to review material previously covered. At the end of the instruction, students in both the "fixed-sequence" and the "branching" group were given the same written posttest, consisting of 51 multiple-choice and 44 fill-in items. Some of the questions on the posttest resembled the training material, while some questions required transfer of the content taught by the program to unfamiliar situations.

Members of the "branching" group scored significantly higher on the posttest than did members of the "fixed-sequence" group. Though members of the "branching" group also averaged shorter training times, this difference was not significant. In a prior study, (Silberman, Coulson, Melaragno, Estavan, note 13) a correlation was found between student aptitude as measured by a pretest and criterion test score. In this study, no such correlation was found. The performance of lower-aptitude students was raised. Differences from the previous study were also that (a) branching was based partly on students' self-assessment instead of only on students' errors, (b) separation was made between instruction items and diagnosis or decision items, (c) remedial items taught topics differently (e.g., inductively instead of deductively) from mainstream items, and (d) no yoked control was attempted so that adaptation could be made much better for the branching group.

Beane (1965) compared linear and branching techniques

using a program on plane geometry. Forty-eight high-school geometry students were assigned to four treatment groups, linear, branching, linear followed by branching, and branching followed by linear, using a stratified random sampling technique. There were 12 subjects in each group. The linear treatment program consisted of 951 completion-type frames bound in five booklets. Answers were entered on separate answer sheets. The branching program consisted of 852 multiple-choice frames in seven booklets, with separate answer sheets. It covered the same material as the linear program, but multiple-choice frames were used, with three alternatives being presented for each question. A 54-item criterion achievement test was administered to the subjects after the treatments were completed, and again seven weeks later. An attitude questionnaire was administered three times--at the completion of half the instruction, at the end of instruction, and seven weeks after the instruction was completed. No significant difference between treatment groups was found for achievement scores or for retention. There was no significant difference in attitude between treatments. The linear group took significantly more time to complete the material than the branching group. High ability students, however, consistently did significantly better than low ability students with the same treatment on achievement, training time, and retention.

Holland, Hoffman, and Doran (note 6) administered a computer-controlled slide program to three groups of 11 children ranging in age from six-and-a-half to seven years old. The

program was a 256-item linear program which used various sequences of colors and shapes to teach inductive reasoning. A linear group was given all 256 items in linear sequence, a branched group used a binary search procedure to locate an appropriate entry point by starting in the middle of the sequence and skipping forward or backward halfway across successively smaller sequences of items depending on whether the items presented were answered correctly or not. A yoked group was made up of subjects randomly paired with individuals in the branched group. The yoked subjects received the sequences generated by their counterparts in the branching group. A pretest similar in form and presentation method to the training program was administered to all the subjects, and following the training sessions a posttest was administered which was also similar to the training program. No significant difference was found in error rate for the branched and yoked groups or for the linear group. The linear group took significantly more time, however, to complete the program. There was no significant difference in time between the branched and yoked groups. There was also no significant difference in the gains in achievement from pretest to posttest for the yoked and branched groups, but the gain for the linear group was significantly greater than the gain for the yoked group.

Holland, Hoffman, and Doran (note 6) undertook another study where the effect of more pronounced differences between yoked subjects and branching subjects was investigated. The apparatus and procedures used were the same as those used in the

previous experiment. Forty-two subjects from the same schools as before were divided into two branching groups and four yoked groups with 14 subjects in each group. The branching groups were made up of subjects who had either all scored high or all scored low on the pretest. Each branched subject was matched with two yoked subjects. Instead of the random pairing used previously, two of the yoked groups were purposely matched or mismatched with a high scoring branched group, and the other two yoked groups were purposely matched or mismatched with a low scoring branched subject. No significant difference between groups was found in the gain from pretest to posttest. No improvement in learning resulted from using the adaptive presentation.

Dyer and Kulhavy (1974) investigated logical compared to random and massed or distributed sequence, where experimental frames were massed or distributed randomly or logically within unrelated "placebo" frames. One hundred sixty-four undergraduate students were divided randomly into seven groups, distributed-logical, distributed-random, massed-logical, massed-random, placebo only, experimental-logical, and experimental-random. Subjects were given a 48-frame program on heart disease adapted from Tobias (note 14), followed by a 32-item constructed-response criterion test and a 32-item multiple-choice criterion test. No time limit was imposed for either criterion test.

Logical sequence yielded significantly higher achievement than did random sequence. No significant difference was found between massed and distributed sequence. An interaction

was found between frame order and practice distribution such that the distributed-random group took the least time to cover the material and had the lowest posttest score, but the other groups had higher scores which were not significantly different from each other. It was concluded that these findings and the findings of previous studies of branching could be explained in terms of the critical factors contributing to attending behavior: One can pay attention and learn effectively if only one of the critical factors of order and separation is altered. When both order and separation are altered, effective learning is no longer possible because more than one critical factor has been altered. This explanation of the findings in terms of two critical dimensions or critical factors is consistent with Tobias's finding that logical sequence (for this purpose a critical factor) is most effective with students who have low prior familiarity with the subject matter.

Summary. The literature on branching contains many apparent inconsistencies and contradictory findings. Many of the positive findings of the earlier studies of branching, for instance, could not be consistently replicated by later investigators.

The back-branching strategy used by Silberman, et al. (1961) was hypothesized to be superior to either of the "fixed-sequence" treatments because it permitted adaptation in the form of remedial iterations of material previously covered. It appears, however, that though the adaptive back-branching

capacity was exercised, it was simply not effective in improving achievement. While the textbook presentation (which permitted students to branch when they needed to) yielded significantly higher achievement, no indication is available on how many students actually did branch, or how frequently they did so, or what the distribution of such branching decisions was, either over time or over the items in the textbook presentation. The differences in training time between forward and backward sequences in the study by Roe (1962) indicate that one or both of those adaptive strategies was indeed actually exercised. The lack of a significant difference in achievement between groups, however, and the absence of interactions between treatment and aptitude for achievement or training time all support the possibility that the forward and backward strategies were simply not well enough differentiated in terms of subjects' prior familiarity with the material to yield significant differences in achievement. The fact that the forward branching approach also was not significantly different from the linear presentation either in terms of achievement or training time lends additional support to this idea. It seems quite possible that the freshman engineering students used by Roe were already familiar with the concepts (though perhaps not with the terminology or notation) of elementary probability theory, and were familiar with most of the computational aspects of the subject matter. The simplest conclusion which can be made on the basis of this evidence (the presence of some learning for both treatments, but the absence

of any interactions) is that a significant part of the material to be learned was already familiar to most of the subjects, but this prior familiarity was not taken into account nor measured in any way.

The study by Coulson, et al. (1962), in contrast to the others, yielded results consistent with what one would expect from branching treatments. The most important feature of this study was that a well-defined difference existed between the mainline program and the remedial alternatives. Not only was a different mode of exposition used for the remedial segments, but the elimination of a yoked control further made it unnecessary to limit the range of responses and presentation methods which could be involved in the adaptive treatment.

Studies of Logical versus Random Sequence

Roe, Case, and Roe (1962) divided 36 freshman psychology students into three groups on the basis of their College Board mathematics scores and administered either of two versions of a program consisting of 71 frames on elementary probability to a randomly selected half of each of the three groups. One version of the program was "logically" sequenced, and the item sequence in the second version was determined randomly. The frames in the program consisted of 4 by 6 inch cards, each containing an item of information and a multiple-choice question. A criterion test was administered as soon as the program was completed.

The type of sequence had no significant effect on

criterion test scores, time required to complete the criterion test, time required to learn the material, or error score during learning.

Levin and Baker (1963) investigated the effect of sequence on retention and transfer. Thirty-six second-grade pupils (13 boys and 23 girls) were matched and randomly divided into two groups of 18 subjects each. Two forms of an 180-item self-instructional program on informal geometry were administered via teaching machines. This program contained five parts--an introductory section intended to acquaint subjects with the teaching machines, and four sections which covered the subject matter: Dots, Lines, Angles, and Triangles. The section on Angles was scrambled in the experimental version of the program. In the course of 17 days for about 15 minutes a day, the subjects were oriented, pretested, and taught to use the teaching machines as a single group in a pretreatment phase which covered the material on Dots and Lines. The group was then divided into two parts on the basis of test scores in the pretreatment phase, matched subjects randomly assigned to one of the two treatments, and the material on Angles was administered. Subjects were then given the Triangles unit, followed by a posttest.

There were no significant differences between the two groups for program time or errors for either the pretreatment, treatment, or posttest phases. There were also no significant differences in retention and transfer. The data indicated a

possibility of an IQ by Treatment interaction (which was not significant) where brighter children did better on logical sequence and lower IQ children did better on the scrambled sequence. Low posttest scores for both groups indicate that the program appears to have been relatively ineffective in teaching the subject matter.

Hamilton (1964) hypothesized that logical sequence with "specific" (explicitly planned for and directed in the instructional material) response mode would yield greater gains in learning than logical sequence and "nonspecific" (general, incidental to the learning task) response mode, while random sequence would yield greater gains in learning with nonspecific response mode than with specific response mode. It was further hypothesized that, in general, specific response mode would yield greater gains than random sequence, and that both logical sequence and nonspecific response mode would yield shorter training times.

Sixty-eight fifth- and sixth-grade students in three separate classes were used as subjects, and three replications of the study were made, one in each classroom. Students were assigned randomly to one of four treatment groups, random sequence and specific response, logical sequence and specific response, random sequence and nonspecific response, and logical sequence and nonspecific response. A 106-item program on the relative time value of musical notes was presented in booklet form. The random-sequence version of the program was obtained by

taking the program as a whole unit with no subsections and generating a different random sequence for each subject to be given a random treatment. A pretest was given to all subjects, followed immediately by the treatment, which was also immediately followed by a posttest.

The random specific program produced significantly less gain in learning than either nonspecific program, but was not significantly different in learning gain from the logical specific program.

Payne, Krathwohl, and Gordon (1967) hypothesized that scrambling would make the greatest difference for programs whose items had a very high degree of logical interrelatedness. One hundred thirty-four college sophomores in an Educational Psychology course were randomly assigned to one of eight treatment groups. Each group received a different combination of logical (L) and randomly scrambled (S) versions of the same three programs on "Percentile Norms," "Age and Grade Norms and Z-scores," and "Validity and Correlation," where these programs were judged to be low, medium, and high respectively in internal dependence. The treatments given were thus logical-logical-logical (LLL), scrambled-logical-logical (SLL), and similarly SSL, SSS, LSS, LLS, LSL, and SLS. The three parts of each treatment contained 60, 59, and 45 frames respectively. Treatments were administered using a question booklet and answer sheet, followed by a criterion test of 56 items. Two weeks later a retention criterion test of 50 items was given.

No significant differences were found between criterion test scores or retention criterion test scores for any combination of treatments.

Brown (1970) hypothesized that the effect of sequence depends on how complex the subject matter is, and how closely it is internally connected. Using 67 tenth- and eleventh-grade trigonometry students as subjects, random assignment was made to a logical sequence condition, a scrambled sequence condition, or to a control group. There were 22, 22, and 23 subjects respectively in each of these groups. A Number Series program (Gagne & Brown, 1961) consisting of 131 frames on 5 by 9 inch cards was the basis for the treatments. This program had been previously shown to possess frame dependency. The first 89 frames of the program were introductory. This was followed by two transition frames and a 40-frame "guided discovery" sequence. For the scrambled sequence condition, the cards were scrambled differently for each subject by using a random number table. Subjects in the two sequence groups worked on the program two consecutive days for about 50 minutes each day. One card at a time was presented to the subject and completed before going on to the next card. The control group received the posttest only. They did not use the program at all. All the subjects were given the posttest on the third day.

Sequence conditions and IQ were independent variables. Dependent variables were training time (time to complete the program), error rate, achievement scores (for tasks during

instruction and for criterion tasks) and an attitude measure. Training time for the logical group was significantly less than for the scrambled group. The logical group also made significantly fewer errors than did the scrambled group. Both logical and scrambled groups performed satisfactorily on the tasks presented during instruction, but only the logical group did satisfactorily on the criterion tasks. For subjects above the median IQ, sequence made no difference in performance on tasks presented during instruction (on-route tasks), but scrambled sequence did adversely affect the on-route performance of lower-IQ subjects. The attitude measure revealed no differences in the logical or scrambled subjects' opinions of how difficult or how interesting the material was.

Niedermeyer, Brown, and Sulzen (1969) hypothesized that logical sequence would yield higher achievement scores, lower error rate, and shorter instructional time than either scrambled sequence or reverse-order sequence. Sixty-four ninth-grade students in two junior high school algebra classes were randomly assigned to four groups, logical, scrambled, reverse order, and a control group, with 16 subjects in each group. They used a modified version of the Gagne and Brown (1961) Number Series program, consisting of 110 frames on 5 by 9 inch cards with the answers on the backs of the cards. There were 61 introductory frames, nine transition frames, and 40 guided discovery frames. A different scrambled sequence was generated for each member of the scrambled group by using a table of random numbers. The

reverse order sequence was generated by simply reversing the logical sequence of cards. The control group received the posttest only, but no instruction at all.

Dependent variables were time to complete the program, error rate, achievement score for the introductory part of the program, posttest score, and an attitude measure. Error rate was significantly lower for the logical group, but there was no significant difference in training time between the logical, scrambled, and reverse groups. None of the three treatments yielded significantly better achievement, though all three were significantly better than the control group. No significant interaction was shown between IQ and treatment.

Tobias (1973c) also investigated random compared to logical item sequence. A 143-frame program on the diagnosis of heart disease was given to 117 undergraduates in two sessions. The program was made up of two parts. The first part contained "familiar" information on the subject; the second part contained "unfamiliar" technical material. Half of the subjects were randomly assigned to a group receiving program items which were randomly scrambled. An anxiety scale pretest was administered and a shorter version of the same test administered during the program and again during the achievement posttest. For unfamiliar content, randomizing frame sequence lowered achievement scores significantly. For familiar material, randomizing frame sequence yielded no significant difference in achievement from logical

sequence. No significant anxiety-treatment interaction was found.

Tobias and Duchastel (1973) studied the effect of a statement of behavioral objectives and of logical or random sequence on achievement. One hundred seventeen psychology students were randomly assigned to four groups. Two groups were given a logical sequence version of an 80-frame computer-presented program derived from a program previously developed by Tobias (note 16). One of these two groups was also given a list of 25 objectives for the instruction, as well as directions on how to use these objectives. The other two groups received a random sequence version of the program, with one of these groups also receiving the additional materials and directions on objectives. An anxiety test was administered to all the subjects before the program was begun. Early in the execution of the program, the objectives groups were reminded of how the objectives were to be used. Halfway through the instruction, another anxiety scale was administered.

No significant difference in achievement was found between the groups which received the statement of objectives and those which did not. The logical sequence groups achieved significantly higher posttest scores than the random sequence groups. No significant interaction was found between type of sequence and the use of objectives. There were no significant effects for time. The random sequence group made significantly more errors on the program than did the logical group. Further,

as test anxiety increased, the number of errors increased.

Summary. The importance of logical or scrambled sequence depends on the degree to which instructional items in a sequence are dependent on each other (i.e., the degree to which one item covers material necessary for understanding the items which follow it). If there is little dependence between items, then the sequence in which they are presented will make little difference in learners' achievement. All three experimental treatments used by Niedermeyer, et al. (1969) taught something, and they all apparently taught it equally well. The fact that the reverse sequence treatment yielded achievement as high as the logical sequence indicates that the items in the program were not highly dependent on each other.

One can intuitively expect that the more a learner knows about the subject matter, the less pronounced will be the effect of item sequence on his or her achievement since the learner's independent prior knowledge of the subject matter will tend to decrease the effects of item dependency. The studies by Roe, et al. (1962) and Payne, et al. (1967) involved both some possible prior knowledge and an unknown amount of internal dependency. The superiority of the "logical" sequence to the "scrambled" sequence in Roe's (1962) study, for instance, would indicate that the terminology was new to the subjects and that the sequence of its presentation was important. Once the new terminology and notation were associated with previously learned concepts however, it appears that the old concepts were easily

brought to bear on a whole new range of problems.

Brown (1970), in contrast, used a program whose frame dependency had previously been empirically established and his findings supported the hypothesis that sequence made a difference in achievement. Brown's (1970) findings can be interpreted to indicate that when the learner has no prior familiarity with highly frame-dependent subject matter, the way that subject matter is presented apparently determines to a much greater extent how it will be learned. This is consistent with Tobias's (1973b) findings that when subjects were familiar with the subject matter, different sequences of presentation yielded no difference in achievement, but that when the subject matter was unfamiliar, sequence made a significant difference in achievement.

Branching in Learner-Controlled Instruction (LCI)

System (or program) control of branching decisions is implicit in most instruction. This implies that the decision-making capacity built into the instructional material or provided by a teacher has most influence on what is learned. This is of course probably never quite the case, since the learner can always make decisions independently of the instructional treatment. When do these decisions by the learner make a significant difference in learning? What (and when) do learners contribute to adaptation? Research on LCI is addressed to these questions.

Definition of Learner Control

Learner control, as the name implies, permits the learner to make decisions about some aspect of the instruction being presented. The content of instruction, its sequence, its pacing, or the medium used may be subject to learner decisions. The instructional variables subject to learner control are of course assumed to actually make a difference in learning the subject matter. Possible interactions between individuals' attributes and those instructional variables must also be taken into account in measuring their effect on learning.

The concept of learner control originated with the findings of Newman (1957), Mager (1961), and Mager and McCann (1961), who found that learners who could choose the mode and sequencing of their own instruction learned more and faster than learners who were given a structured, completely-defined fixed course of instruction. Most of the significant findings in the area of learner-controlled instruction are summarized in Judd, O'Neill, and Spelt (1974a, 1974b). Further relevant concepts, issues, and applications in the area have been explored by Lahey, Crawford, and Hurlock (1976), Fredericks (note 4), Mayer (note 8), Milner (note 9), O'Neal (note 11), and Treffinger and Davis (note 20).

Representative LCI Studies

Judd, O'Neill and Spelt (1974a,b) investigated the effect of learner control on achievement and anxiety. One

hundred sixty-two undergraduate psychology and statistics students were divided into a treatment absent group, a treatment present group, a learner-control with limited instructions group, and a learner-control with extended instructions group. The treatment in this study was a set of mnemonics for identifying edible plants.

Each group was given a task-specific memory test, a locus of control scale, and an achievement-via-independence questionnaire, then given a two-hour computer-based program on the identification of edible plants, based on one of the four treatments. This program was administered in two segments: First an Anxiety Scale; then Segment One (which covered five plants) followed by another administration of the Anxiety Scale. Segment Two was then given, followed by the Anxiety Scale once more, and a Post-Instructional Interview. The use of mnemonics was found not to be generally facilitating. Learner-controlled access to mnemonics did not facilitate achievement, and learner control did not lessen anxiety.

Mayer (1976) hypothesized that pretraining with a concrete model and the use of learner control would result in acquisition of a qualitatively different learning set involving emphasis on structure as contrasted to procedures, and that item sequence would yield differences for long, sequence-dependent material but not for short sequences of items. Eighty college undergraduates were randomly assigned to eight groups, based on a model or no model condition using a concrete model of a com-

puter, a logical or scrambled condition, and an LCI or No-LCI condition. The model for pretraining was a 3 X 2-foot board representation of a computer, accompanied by an explanation of its functioning. A 26-frame text on index cards containing definitions and examples of seven kinds of FORTRAN statements was administered to each group using the appropriate treatment, followed by an 18-card deck of test items from which questions were generated. All subjects received the same test.

While subjects who were pretrained achieved significantly better than those who were not, sequence made no significant difference in achievement. An interaction was also found where learner control and pretraining facilitated transfer of information to new situations, while the no-learner-control and no-pretraining treatments facilitated subjects' application of the information to problems which were similar to the examples given in the treatment.

Summary of LCI Research

Learner control of instruction has been hypothesized to yield more thorough learning of subject matter in a shorter time, and to yield more self-directed students with more positive attitudes toward the instruction (Mager, 1961; Mager & McCann, 1961). The actual findings have not consistently supported these hypotheses, however, because the learners' attributes which make those results possible have apparently not always been present. The subjects used in the first studies in

this area (Mager, 1961; Mager & McCann, 1961) were mature, highly motivated students with a relatively sophisticated background in the subject area. While Campbell and Chapman (1967) and Davis (1971) also observed similar results with grade school and college level subjects, non-significant findings by Barnes (note 1), Fry (note 5), Judd, Bunderson, and Bessent (note 7), and Olivier (note 10) lead to the conclusion that while learner control is generally perceived in a positive way, significant improvements in achievement have only been observed when relatively informed or sophisticated, highly motivated learners are involved. Grubb's (1969) findings that the use of a "map" with learner control so as to enable learners to relate the parts of a subject area to one another yielded higher achievement also confirms that learners' increased prior knowledge of the subject area makes learner control more effective.

Learner control of instructional decisions has been shown to be effective when the variables under learner control actually can have a significant effect on learning, when the learner expects to make instructional decisions, and has sufficient information or prior knowledge on which to base decisions.

Prior Familiarity as an Experimental Variable

We intuitively expect that a learner's prior knowledge of subject matter should affect his performance during the course of instruction, as well as his achievement on criterion test items so that the more familiar he is with the subject

matter, the better he should be able to perform. Prior familiarity with the subject matter can be conveniently operationally defined for a specific body of subject matter in terms of achievement pretest scores.

Tobias (1969) investigated prior familiarity in conjunction with creativity and response mode. One hundred volunteers from undergraduate Educational Psychology classes (66 females and 34 males) were divided into a high creativity and a low creativity group and were administered either a constructed response version or a reading version of a program on heart disease (Tobias, note 14). Both versions of the program had a familiar and a technical (unfamiliar) part, with the unfamiliar technical part of both versions containing a verbal and a pictorial part. Subjects were pretested, given one of the treatments, then administered a posttest as soon as the program was completed.

The high creativity group did significantly better than the low creativity group for both response modes. Constructing responses yielded significantly higher achievement than the reading response for the technical material. No significant difference in achievement was found between response modes, however, for the familiar materials.

Tobias and Abramson (1971) in the study previously described found that for unfamiliar content, high facilitating anxiety yielded higher achievement, as did stress in combination with constructed responding. For familiar content, however,

stress and debilitating anxiety yielded higher achievement.

Tobias (1973b), in comparing scrambled and logical sequence in the study previously mentioned, found that scrambling made a difference for unfamiliar, but not for familiar, instructional content.

Abramson and Kagen (1975) administered a program on the diagnosis of heart disease to 60 graduate psychology students (30 males and 30 females). The program, consisting of 89 frames containing technical verbal and pictorial information, was developed by Tobias (note 14). This technical information was also prepared in a reading version which required no overt responses from the subjects. Material in the form of a list of ten technical terms and five EKG tracings was also prepared to pre-familiarize subjects with the technical content of the instruction. Half of the subjects were randomly assigned to a "pre-familiarization" group, and half to a "nonfamiliarization" group. Each of these groups was in turn randomly subdivided into a "constructed response" and a "reading" group. Pre-familiarization consisted of subjects' copying the list of technical terms twice and memorizing it, then reproducing it from memory. Subjects were then asked to match two groups of five tracings, and to draw a copy of each tracing to complete the pre-familiarization. Each presentation of the program or reading material was immediately followed by a posttest. The same posttest was administered again about a week later.

None of the factors of response mode, prior familiarity,

and sex yielded consistently significant differences in posttest scores. The males did significantly better on the posttest tracing score, while the constructed response and prefamiliarization groups scored significantly higher on the delayed posttest tracing scores. There was a significant interaction between response mode and familiarization, with pre-familiarization yielding higher tracing posttest scores for the reading group, but lower scores for the constructed response group, which had higher scores for the nonfamiliarization condition. A significant response mode by familiarization by sex interaction was also found. For the males, pre-familiarization yielded high achievement for the reading group and lower achievement for constructed responses. For the females, an ordinal interaction resulted, with constructed responses giving higher scores for both prefamiliarization and nonfamiliarization, and an increase in achievement score for constructed responses with prefamiliarization.

Tobias and Ingber (note 18) hypothesized that as students' prior achievement increased, they would need less instructional support to achieve at the same level. One hundred four parochial school students (52 females and 52 males, where 47 were from a Catholic parochial school and 57 were from a Jewish parochial school) were given a 37-frame linear program dealing with Jewish ritual. A constructed response version of the program was presented in booklet form, three items to a page with the presentation on the left and feedback for responses on the right of each frame, where the feedback items were covered

by a paper tab. A reading version of the program was created by filling in the responses in each frame. A pretest requiring constructed responses was administered, followed by the program, then a posttest identical to the pretest, and an attitude scale.

The constructed response treatment yielded significantly higher achievement than the reading treatment for both high and low pretest scores. As predicted, a significant interaction was found between response mode and pretest score. While a higher level of instructional support yielded consistently higher achievement, as learners' prior familiarity increased achievement also increased so that the level of instructional support made less difference.

Tobias and Litwak (note 19) further explored the interaction between prior familiarity and instructional support. Seventy-seven Catholic and 64 Jewish parochial elementary students were given a constructed response version, a reading version, or a text version of the program used by Tobias and Ingber (note 18). A pretest administered one week before the program was given, a posttest was given immediately after the instruction, and a delayed posttest was administered one month later.

For no prior familiarity, constructed responding yielded the highest achievement. For prior familiarity with low pretest score, reading yielded the best achievement, though as pretest

score increased the differences in achievement between response modes became non-significant.

Ross, Rakow, Bush and Cervetti (Note 12) investigated adaptation and prior familiarity in self-managed learning using 105 undergraduate educational psychology students in a PSI (Personalized System of Instruction--Keller Plan) course dealing with mathematical rules. Subjects were given a pretest and rule prescriptions for individual instruction were then formulated. The instruction for each rule in turn was administered, followed by a survey questionnaire to minimize short-term recall; finally a posttest was administered. For each rule, a booklet was provided corresponding to the specified rule prescription which contained a study section, a problem-solving section, and an immediate short posttest.

Rule example prescriptions were either Standard, Adaptive, or Mismatch. Standard treatments used five examples for each rule, while Adaptive treatments used one less example for each pretest score point above the mean and one more example for each pretest score point below the mean; and the Mismatch treatment did the reverse. Incentives (point value associated with each rule to be learned) were also Standard, Adaptive, or Mismatch.

With pretest score as an indicator of prior achievement, the Adaptive Examples treatment (more instructional support) gave higher posttest achievement with less difference between prior achievement levels than did either the Standard or Mismatch

treatments. Mismatch interacted with Adaptive treatment so that there was little difference between the two for high prior achievement, but low prior achievers performed even more poorly with the Mismatch treatment. For instructional time, Adaptive Examples took less time than Standard Examples, and also interacted with Standard and Mismatch so that while those treatments had little difference in time Adaptive Examples took more time for low prior achievement and less time for high prior achievement. Effectiveness ratio (posttest score divided by instructional time) was higher for Adaptive Examples than for Standard Examples and Mismatch, except for the lowest level of prior achievement where Mismatch was highest. These findings further support the conceptualization that the lower the level of prior achievement, the more instructional support is needed to achieve at any given level while high levels of prior achievement require less instructional support.

Deutsch and Tobias (note 3) investigated the effects of prior achievement, anxiety, and instructional method. One hundred twelve educational psychology students in five classes were shown four videotape modules dealing with individualized instruction. Two of the classes viewed the modules on individually controlled equipment and were instructed to rewind the tape whenever they felt it was necessary to go back over the material. The other three classes viewed the modules as a class group, with no provision for rewinding the tapes. Before the first module, a

Test Anxiety Scale and a Worry-Emotionality scale were administered, followed by a pretest on the material to be covered. After the fourth module was viewed, the Worry-Emotionality scale was administered again, followed by a posttest. Those subjects who viewed the modules independently with the capability for individual backup of the tapes had significantly higher posttest scores than those who viewed the modules as part of a class group. A significant interaction was also found between treatment and test anxiety, and between treatment and posttest scores.

Instructional support in the form of the capability for rewinding the tapes made less difference for high prior familiarity students than when students had less prior familiarity with the material. Anxiety detracted most from students' performance when they viewed the modules in a group and could not rewind the tapes. For the independent viewing treatment there was little difference between high and low anxiety levels, and for low anxiety levels there was little difference between independent and group treatments.

Pascarella (1978) investigated the effect of prior familiarity and instructional method on achievement using 248 undergraduates in the first semester of an introductory calculus course. Sixty students took a PSI (Keller Plan) version of the course (high instructional support), while 188 students took a conventional lecture version (low instructional support). The high support treatment was self-paced, provided detailed study guides for each unit, provided tutorial sessions for

individualized help and testing, provided optional lecture and problem solving sessions, and required mastery of each unit (demonstrated by passing a unit test) before going on to the next. Students took the unit tests whenever they thought they were able to pass the unit test. If a unit was not mastered on the first attempt, remedial work was provided and alternate forms of the unit test were given until mastery was achieved. The low support treatment provided three hours a week of lecture and problem solving sessions. Before either treatment, students were given a mathematics placement examination to determine level of prior mathematics preparation, and both groups were given the same end-of-semester examination.

Significant effects were found for level of prior mathematics preparation and for level of instructional support, and a significant interaction was found such that for lower levels of prior mathematics preparation high support yielded higher achievement than low support while for higher levels of prior preparation there were no significant differences in achievement between treatments.

Replication of the study using the same treatments, with 53 students taking the PSI course and 57 students taking the lecture course, yielded essentially the same results. These findings provide further empirical evidence of an interaction between prior achievement and level of instructional support.

General Summary of Findings

Cronbach's (1957,1975) work, the conceptual explorations of Bracht (1970), Salomon (1972), and Tobias (1976); and empirical work such as Ott's (Ott & Macklin,1975), Salomon's (1974), and Trown and Leith's (1975) studies have established that no single treatment is likely to work uniformly well for all learners in a real-life classroom setting. The most fruitful generalizations for adaptive instruction will thus usually be expressed in terms of interactions between learners' attributes and type of treatment.

In the studies considered here, the learner attribute of prior familiarity has interacted consistently with type of treatment. The data consistently show that when a learner has little prior familiarity with the subject matter, type of treatment significantly influences level of achievement. As level of prior familiarity increases, the level of instructional support (adaptation added to the instruction) resulting from type of treatment has less influence on achievement. The findings of the studies by Silberman et al (1961) and Roe (1962) as well as the data of Coulson, et al (1962) and the findings of the other branching studies can be reconciled in terms of this interaction since none of these studies took learners' prior familiarity into account. Re-examination of the findings of these studies shows that the seemingly contradictory non-significant results have been found where subjects most likely had a high level of prior familiarity with the subject matter.

The studies by Tobias (1969,1973b,c), Brown (1970), Tobias and Ingber (note 18) and Abramson and Kagen (1975) show that prior familiarity interacts with several treatment variables. One interesting possibility for further investigation is the concept of learner control, which allows us to take complex multidimensional interactions between several learner attributes and types of treatment and deal with them operationally in terms of decisions made by individual learners. Learner control is of course basically a branching strategy, and can be described in terms of the decision-making paradigm and the three basic constructs (linear, repetition, and alternatives) described earlier. Learner-controlled branching is a quite sophisticated form of instructional support (i.e., adaptation which facilitates learning). The present interest in this form of branching lies in the way it also interacts with learners' prior familiarity with subject matter.

Instructional support is adaptation which is added on to instruction. It represents something extra which is done to facilitate learning. Conceptually, however, forward skipping means that less of an instructional presentation will be used, because the support implied is not needed by the learner. While forward skipping is certainly a valid means of adaptation, it actually implies a reduction of unnecessary instructional support. The "full" or non-branching version of the same instruction embodies the maximum possible instructional support. One gains adaptation but not instructional support by using a forward

skipping strategy. Greater prior familiarity implies less instructional support is needed, which in turn implies more forward skipping will be used.

Branching in the form of forward skipping is a simple and readily implemented form of adaptation which can be applied to most subject matter presentations. Forward skipping should be appropriate when learners already know parts of the subject matter to be presented and thus do not need to cover material already familiar to them (i.e., do not need as much instructional support as learners who know nothing at all about the subject matter). A presentation with no skipping, in contrast, should yield the same learning but should take longer, with perhaps more frustration due to redundancy or "wasted time" for learners who are already familiar with the material. The research outlined here was intended to explore the possible interaction between a forward skipping branching treatment and learners' prior familiarity with the subject matter.

CHAPTER III

RESEARCH DESIGN

The variables manipulated were (a) prefamiliarization or nonprefamiliarization, and (b) type of treatment-- branching, linear or yoked. Posttest score, time to complete the instruction, error rate, and attitude toward the instruction were dependent variables.

Two levels of prior familiarity, prefamiliarized and not prefamiliarized, were used. Prefamiliarization was separate from the instructional CAI treatments.

Three types of treatment were administered, either a forward skipping treatment, a linear treatment with no skipping at all, or a yoked treatment where the sequence of items for each subject was the same as the sequence chosen by a forward skipping subject with whom each yoked subject was randomly paired.

Hypotheses

Level of prior familiarity will interact with sequence so that:

Posttest achievement. For students who are prefamiliarized, linear treatment scores will be lower than branching treatment scores, and yoked scores will be lowest. There will be no significant difference between the three nonfamiliarized groups.

Errors. Students who are prefamiliarized will make fewer program errors than those who were not prefamiliarized.

Time. Students who are prefamiliarized will take less time for the branching treatment than for the linear treatment or the yoked treatment. Students who are not prefamiliarized will take the same time for linear, branching, and yoked treatments.

Attitude. For the linear treatment, subjects who are prefamiliarized will have less positive attitudes toward the instruction than those subjects who were not prefamiliarized.

Method

Three versions of a computer-assisted instruction (CAI) program on RUNOFF, a computer-based text formatting program, were given to three groups of subjects. One group used a linear (no skipping) version of the instructional program, a second group used a version of the program which permitted forward skipping, and the third group was a yoked control for the second group. One half of each group was prefamiliarized on about half the subject matter covered in the lesson, while the other half was not prefamiliarized. Posttest achievement was conceptualized as made up of two components. One component, reflecting the effect of prefamiliarization, corresponded to the prefamiliarized commands which made up the subject matter. The other component reflected the effect of the instructional treatment, and corresponded to the commands which were not prefamiliarized. The posttest and an attitude questionnaire were administered after the completion of the instructional program.

Subjects

The subjects were 120 adult volunteers, 84 females and 36 males, in six treatment groups of 20 persons each. Of these, eighty-seven (62 females and 25 males) were clerical and administrative employees of Digital Equipment Corporation in Maynard, Massachusetts. Typical job titles included secretary, librarian, administrative assistant, order entry clerk, financial analyst, recruiter, writer, employee relations representative, receptionist, and data entry clerk. Subjects in administrative and clerical support jobs were mostly sought because this was a large available population with a widely varied background where it would be most likely that a very large proportion of the population had had no previous contact with the subject matter to be taught. The remaining thirty-three subjects (22 females and 11 males) were individually recruited, and were comparable in background, range of education and experience to the rest. The distribution of subjects by sex for the total group and for the individually recruited subjects is shown in Table 1. Typical occupations included administration or clerical work, undergraduate student, and public school teaching. None of the subjects knew the RUNOFF material presented in the instructional program beforehand. This was determined by interviewing each subject before administering the treatment, by asking about prior acquaintance with RUNOFF during the posttest, by including an item dealing with prior knowledge of RUNOFF

Table 1
 Distribution of Subjects by Sex
 for Total Group and for Individually Recruited Subjects

	Total Group		Individually Recruited	
	Females	Males	Females	Males
Prefamiliarized Group				
Linear	16	4	5	2
Branching	10	10	2	2
Yoked	14	6	2	3
Group Total	40	20	9	7
Non-Prefamiliarized Group				
Linear	16	4	2	1
Branching	13	7	5	1
Yoked	15	5	6	2
Group Total	44	16	13	4
Grand Total	84	36	22	11

in the attitude questionnaire, and by interviewing subjects after the sessions.

Apparatus and Materials

Apparatus and materials consisted of the instructional programs, the posttest, the prefamiliarization booklet, and the attitude questionnaire.

Instructional Programs. The basic instructional program consisted of 84 instructional items and 36 branch test items. The subject matter covered 15 RUNOFF commands, plus information on how commands were formatted and a general introduction to the terminal keyboard. The commands included were:

1. PS (PAGE SIZE) for setting page size in lines and columns.
2. RM (RIGHT MARGIN) for setting the right margin in a specified column.
3. SP (SPACING) to set line spacing.
4. P (PARAGRAPH) to set paragraph indent and spacing in columns and lines.
5. AP,NAP (AUTOPARAGRAPH, NOAUTOPARAGRAPH) to turn automatic paragraph feature on and off.
6. C (CENTER) to center text.
7. T (TITLE) for setting titles.
8. S (SKIP) to skip lines.
9. LS,LE,ELS (LIST, LIST ELEMENT, END LIST) to create lists of items.

10. F,NF (FILL, NOFILL) to turn text justification on and off.

11. TS (TAB STOPS) for setting tab stops in specified columns.

The instructional items for each command were presented together in a block. There were 12 such blocks, and each block of similar items was preceded by three branch test items dealing with the same material. For the forward skipping version of the instruction, if any of the three branch test items was answered incorrectly then the subject was skipped directly into the block of instructional items, and was given all the instructional items in that block. If all three branch test items were answered correctly, then the block of instructional items was skipped over and the next set of branch tests was presented.

For the linear version of the instruction, all the branch tests were included in the presentation and no skipping took place. All the branch tests were given whether or not they were answered correctly, and all the instructional items were always presented. None of the branch tests in any version of the instruction contributed to subjects' scores. Table 2 summarizes the distribution of items in the instructional program for branch test items and instructional items for each

Table 2
Summary of Item Distributions

Command	Branch Tests	Instruction	Total	Posttest Items
PREFAMILIARIZED				
PS	3	6	9	5
RM	3	6	9	4
SP	3	6	9	5
P	4	7	11	5
C	3	6	9	4
S	3	6	9	5
F	2	3	5	4
TS	3	5	8	5
Prefamiliarized Total	24	45	69	37
UNFAMILIARIZED				
Format	3	6	9	1
AP	1	4	5	5
NAP	1	2	3	3
T	3	6	9	3
LS	1	4	5	5
LE	1	10	11	9
ELS	1	4	5	5
NF	1	3	4	5
Keyboard	1	0	1	-
Unfamiliarized Total	13	39	52	36
Grand Total	37	84	121	73

RUNOFF command. This distribution is shown in detail in Appendix A.

The items in the instructional program were created using the GNOSIS author language on a PDP-10 computer. GNOSIS uses a script containing the text to be presented and a set of keywords which identify segments of text, questions to be presented, correct answers to be checked, and possible wrong answers or missing text. The basic instructional presentation was created using the GNOSIS script in Appendix B. The linear instructional presentation dialogue is shown in Appendix C. Items were presented the same way for the linear, forward skipping, and yoked instruction. The only difference between instructional presentations was in the absence of items which were skipped in some versions of the instruction.

Instructional question items contained text which always required a response from the subject. If this response matched one of the possible RIGHT answers supplied in the script, an appropriate feedback message such as "Correct" or "That's right" was automatically supplied and the next item was presented. If no match was made with a RIGHT answer or if a WRONG answer was matched, the system automatically provided a message such as, "wrong," or "that wasn't correct" and the item was presented again. If some part of the text was specifically lacking a message was displayed and the item was presented again. If nothing was lacking and no RIGHT answer was matched after three tries, then the subject was given the

correct answer, which was taken from the first RIGHT answer provided in the script. If a RIGHT answer was eventually matched after an initial incorrect try, a message such as, "you're doing better" or "you can do it, now" was provided and the next item was presented.

GNOSIS contains a facility for recording WRONG answers, recording answers lacking any required text and for recording a summary of the total number of items presented, number correctly answered, and the number of first rights in a scoring file. This scoring file was retrieved at the end of each session.

Average execution time for the linear version of the program was one hour and ten minutes. The forward skipping version took 55 minutes.

Posttest. The posttest contained two items on prior use of terminals and prior acquaintance with RUNOFF, followed by 60 items dealing with the RUNOFF commands presented in the instructional program. Of the 60 posttest items given, 52 items required only one command for a correct response. Each of these items was worth one score point. The other eight posttest items required two or more commands on one line for a correct response, and these items were worth a total of 21 points. The entire posttest was worth a maximum of 73 score points. The distribution of subject content and score values across posttest items is summarized in Table 1 and is shown in detail in Appendix A.

The posttest script is shown in Appendix D. The same

version of the posttest was used for all subjects. Posttest items were presented to subjects in all groups in the same sequence. All feedback messages which could be eliminated from the posttest were done away with, and each posttest item was presented only once. Incorrect answers yielded the response, "The program did not understand your answer," and the next item was presented. Correct answers to posttest items produced no feedback at all. The posttest dialogue is shown in Appendix E. The posttest took an average of thirty minutes to complete.

Prefamiliarization Booklet. The Prefamiliarization Booklet is shown in Appendix F. The booklet consisted of a ten-page workbook containing an explanation, examples, and a workbook page each for the P, TS, S, PS, SP, C, RM, and F commands, plus directions for completing the workbook. Each command was given a double-page presentation where the left-hand page included a large display of the abbreviated command, an explanation of the meaning and the format of the command, and three examples of how the command was used. Each right-hand page contained three paper-and-pencil workbook questions based on the information shown on the left-hand page. The number and distribution of instructional items and posttest items prefamiliarized is summarized in Table 1 and a detailed breakdown is given in Appendix A.

Attitude Questionnaire. The Attitude Questionnaire consisted of 21 items using a four-point Likert scale plus one item intended to check on subjects' prior acquaintance with RUNOFF. Three of the attitude items were dropped from the

analysis in the pilot study, so that only 18 items were used in the analysis although a total of 22 items was still administered. Items were answered on a four-point scale ranging from (1) Strongly Agree, which indicated the most positive attitude, through (2) Mildly Agree and (3) Mildly Disagree to (4) Strongly Disagree, which indicated the most negative attitude. The distribution of questionnaire items and the actual questionnaire are shown in Appendix G. The questionnaire was administered in a paper-and-pencil form and the results transcribed to a computer file for analysis.

Collection of counts and timings. For each subject, a scoring file was created for the instructional presentation, another scoring file was created for the posttest, and the attitude questionnaire items were collected and transcribed to a computer file. These data were collected in a data matrix file.

Yoked Treatment

A yoked treatment was used in addition to the linear and forward-skipping treatments. Members of the yoked group were randomly paired with members of the forward-skipping group, and a yoked treatment was created by using the scoring file from each forward-skipping presentation to determine the sequence and content of a corresponding yoked presentation. Yoked items were presented linearly, with no skipping possible. Yoking was accomplished only in terms of item sequence; branch test items still did not contribute to subjects' scores, and the number of times an instructional item was repeated

depended on whether it was answered correctly or not.

What was the rationale for yoked groups? Since each member of the yoked control group used an item sequence which presumably was ideally adapted only for the individual who created that sequence originally, the yoked group was not expected to score as well as the original individuals in the forward skipping group. The yoked group was thus expected to reflect differences in achievement, time, or attitude due to non-adaptive branching.

Yoked sequences were created using a program which assembled a new GNOSIS script for each yoked treatment. This program read each scoring file from a forward skipping treatment and retrieved the sequence of items actually taken by that subject. Each item taken in the actual forward skipping sequence was then copied from the original linear script into a new yoked script. This yoked script was then used with the GNOSIS translator to generate a linear instructional program with the same item sequence as that taken by the forward-skipping individual. For the yoked version of the instruction, only those branch tests taken by the forward skipping member of the yoked pair were given to the yoked subject. Yoked subjects' answers to branch tests had no effect on which items they were presented, since this was determined by what the forward skipping subject had already taken.

Procedure

Subjects were given each treatment individually, and

the checklist of procedures shown in Appendix H was used to ensure consistent treatment of subjects. The Consent Form shown in Appendix H was read and signed by each subject.

Assignment of subjects to treatments. As they became available, individuals were randomly assigned to a linear, forward-skipping, or yoked treatment and a prefamiliarized group or non-prefamiliarized group by using the following procedure:

1. Assign the individual to either a prefamiliarization (heads) or non-prefamiliarization (tails) treatment by tossing a coin.

2. Assign to either a linear (heads) or branching (tails) treatment by tossing a coin. If the decision is for a linear treatment in the previous step, then the next two subjects available must be assigned to the skipping and yoked treatments in that order, because the skipping sequence must be available before a yoked path can be created.

3. If the forward-skipping treatment is indicated in step 2, then either a linear (heads) or a yoked (tails) treatment is assigned to the next available subject on the basis of another coin toss.

4. If a group fills up, (i.e., has 20 members) then skip the coin toss for assignment to that group. When only one group remains to be filled, put all the remaining subjects into that group.

Information sheet. The information sheet shown in Appendix H was given to each subject at the beginning of the

treatment, and each subject was asked to read it and save it. This information sheet contained all the general information needed by each subject to function on the terminal, and also contained the ID assigned to that subject. The instructional programs and the posttest requested this ID from each subject so as to set up the appropriate scoring file for each session.

Prefamiliarization. For the subjects who were to be prefamiliarized, the prefamiliarization booklet was then issued, the directions for working with it described, and the booklet completed as a paper-and-pencil workbook exercise. There was no time limit for completing this booklet, and subjects were not timed. Subjects were told to complete it at their own pace, and were reminded that they would not have it when they began work on the terminal. Directions for completing the prefamiliarization are shown in Appendix F.

Terminal session. The terminal was set up (i.e., logged in, display line width set, and upper case characters set) and the appropriate program started for each subject. Once the program began execution, the only monitoring done was to ensure that the subjects' interaction with the program went on smoothly with no mechanical or computer system failures. At the end of the instructional program, each subject was automatically logged off the computer system by the program.

Posttest session. This was conducted in the same way as the preceding terminal session. Once the terminal was set up and the posttest started for each subject, there was again

no further monitoring except to ensure that everything ran smoothly. At the end of the posttest, each subject was again automatically logged off the system.

Attitude questionnaire. The Attitude Questionnaire was administered as a paper-and-pencil exercise after the completion of the posttest. There was no time limit for completion of the questionnaire. Directions for completing the questionnaire are shown in Appendix G.

Scoring procedure. The instructional presentation and the posttest were scored using a command facility on the computer system which automatically invoked the scoring programs as each subject completed the session on the terminal, and added the new output to a data matrix file. Use of this system facility made it possible to quickly and reliably run the scoring programs and retrieve data for analysis.

CHAPTER IV

RESULTS

Familiarization and type of instructional sequence were independent variables. A 2 X 3 analysis of variance (2 levels of familiarization by 3 levels of sequence) was used to analyze the data.

Rationale for Dependent measures

The dependent measures were selected to provide tests of the hypotheses regarding achievement, time, errors, and attitude; to provide an assessment of the effectiveness of the prefamiliarization; and to measure performance on the instructional program. Total posttest score, posttest score for the subset of prefamiliarized commands, posttest score for the subset of non-prefamiliarized commands, total time for the instructional program, efficiency ratio, per cent of branch tests correct, and attitude score were used to test the hypotheses. Number of script items presented, total posttest score, and per cent of branch tests correct were used to assess the effectiveness of the prefamiliarization. Number of instructional trials and mastery level were also used to assess performance on the instructional program.

Tests of the Hypotheses

The hypotheses pertaining to achievement, time, errors and attitude were tested using the following measures:

Total posttest score. The posttest consisted of 73 items, each with a score value of one point. The maximum possible posttest score was 73 points, which were distributed as shown in Table 2. The means, SDs, and percentages correct for total posttest score are shown in Table 3. A significant effect, $F(1,114)=10.839$, $p < .001$ was found for familiarization, where prefamiliarized groups had higher scores than non-prefamiliarized groups (see Table 4). No effect was found for sequence and no interaction was found. The hypothesized sequence by familiarization interaction was not confirmed.

Table 3
Means, SDs and Percentages for Total Posttest Score

	Mean	Std. Dev	Percent
Prefamiliarized Group			
Linear	53.90	12.64	74
Forward Skipping	49.30	16.49	68
Yoked	48.35	16.49	66
Group Total	50.52	15.25	69
Non-Prefamiliarized Group			
Linear	40.30	16.84	55
Forward Skipping	37.90	19.60	52
Yoked	45.10	10.06	62
Group Total	41.10	16.03	56
Total	45.81	16.03	63

Table 4
 Analysis of Variance of
 Total Posttest Score

	Sum of Squares	df	Mean Square	F
Main Effects				
PREFAM	2660.208	1	2660.208	10.839*
SEQUENCE	295.417	2	147.708	0.602
Interaction				
PREFAM X SEQUENCE	594.617	2	297.308	1.211
Residual	27978.350	114	245.424	
Total	31528.592	119	264.946	

* $p < .001$

Posttest score for prefamiliarized commands. The PAGE SIZE, RIGHT MARGIN, SPACING, PARAGRAPH, CENTER, SKIP, FILL, and TAB STOPS commands were prefamiliarized. These commands were covered in 37 posttest items which were worth one point each. The means, SDs, and percentages correct for the posttest scores for this subset of commands are shown in Table 5. For this subset of commands, posttest scores for the prefamiliarized treatment were significantly higher than posttest scores for the non-prefamiliarized treatment, $F(1,114)=31.66$, $p<.001$, and a sequence by familiarization interaction was also found, $F(2,114)=3.07$, $p<.05$ (see Table 6) such that the non-prefamiliarized linear and branching treatments yielded lower scores than the non-prefamiliarized yoked treatment, but for the prefamiliarized treatments the yoked treatment yielded the lowest score.

Table 5
Means, SDs and Percentages for
Posttest Score for Prefamiliarized Commands

	Mean	Std. Dev	Percent
Prefamiliarized Group			
Linear	27.10	7.44	73
Forward Skipping	24.25	8.46	65
Yoked	22.60	8.38	61
Group Total	24.65	8.18	67
Non-Prefamiliarized Group			
Linear	15.20	8.36	41
Forward Skipping	14.75	9.51	40
Yoked	19.30	5.29	52
Group Total	16.42	8.06	44
Total	20.53	9.08	55

Table 6
 Analysis of Variance of
 Posttest Score for Prefamiliarized Commands

	Sum of Squares	df	Mean Square	F
Main Effects				
PREFAM	2033.633	1	2033.633	31.656**
SEQUENCE	64.867	2	32.433	0.505
Interaction				
PREFAM X SEQUENCE	393.867	2	196.933	3.066*
Residual	7323.500	114	64.241	
Total	9815.867	119	82.486	

* $p < .05$

** $p < .001$

Posttest score for non-prefamiliarized commands. The subset of commands which were not prefamiliarized included AUTOPARAGRAPH, NOAUTOPARAGRAPH, TITLE, LIST, LIST ELEMENT, END LIST, NO FILL, plus items on RUNOFF command format and the terminal keyboard. These were covered in 36 posttest items which were worth one point each. The means, SDs, and percentages correct for this subset of posttest items are shown in Table 7. For the subset of non-prefamiliarized commands, no significant effects and no interaction were found (see Table 8).

Total posttest score and scores for the prefamiliarized and non-prefamiliarized components of the total posttest score are shown graphically in Figure 3 so as to clarify their relationship.

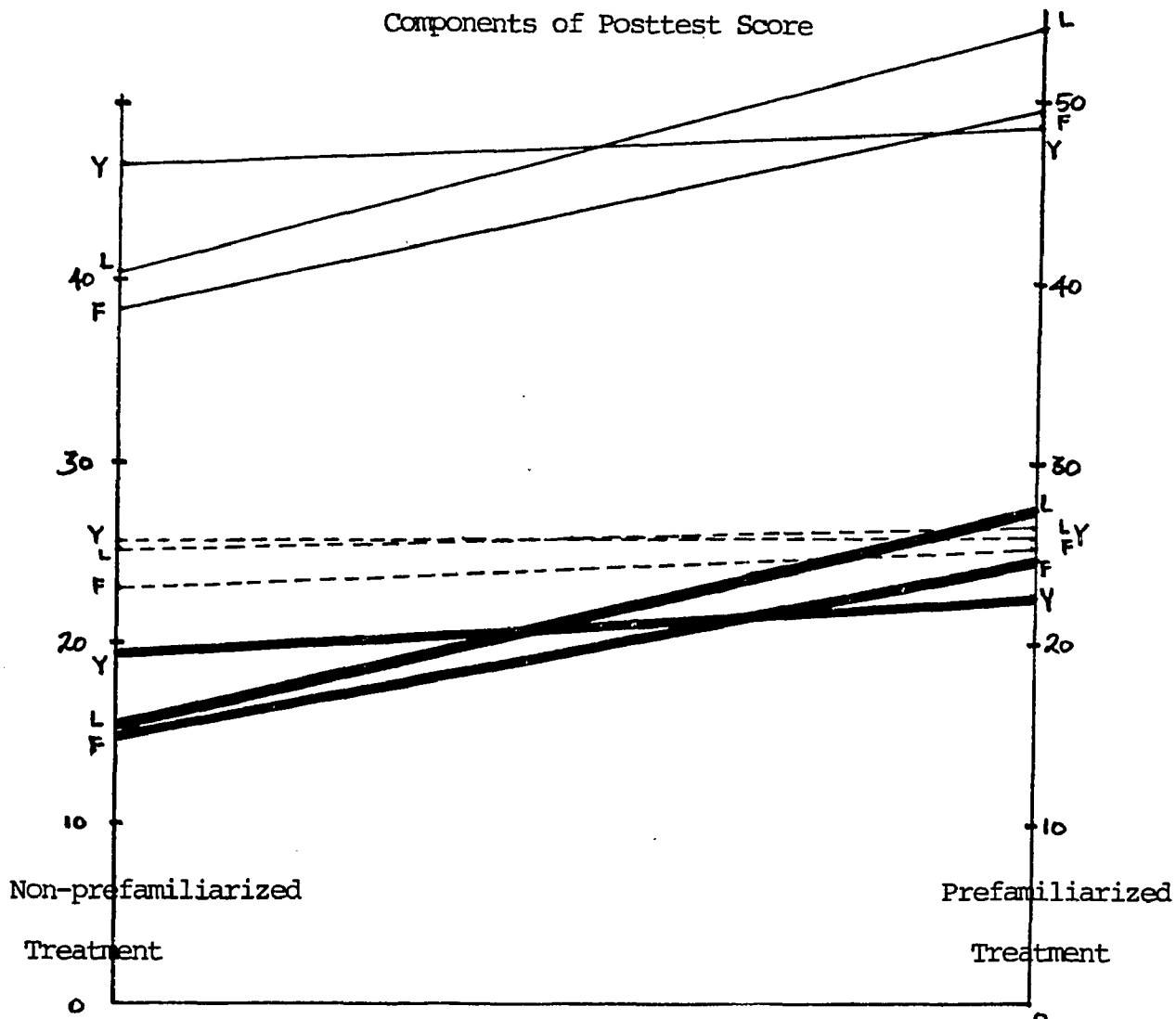
Table 7
Means, SDs and Percentages
for Posttest Score for Non-prefamiliarized Commands

	Mean	Std. Dev	Percent
Prefamiliarized Group			
Linear	26.80	6.99	74
Forward Skipping	25.05	8.58	70
Yoked	25.75	8.93	72
Group Total	25.87	8.10	72
Non-Prefamiliarized Group			
Linear	25.10	9.96	70
Forward Skipping	23.15	10.82	64
Yoked	25.80	5.94	72
Group Total	24.68	9.07	69
Total	25.28	8.59	70

Table 8
 Analysis of Variance of
 Posttest Score for Non-Prefamiliarized Commands

	Sum of Squares	df	Mean Square	F
Main Effects				
PREFAM	42.008	1	42.008	0.555
SEQUENCE	83.450	2	41.725	0.551
Interaction				
PREFAM X SEQUENCE	23.017	2	11.508	0.152
Residual	8625.450	114	75.662	
Total	8773.925	119	73.730	

Figure 3
 Prefamiliarized and Non-prefamiliarized



_____ Total Score
 - - - - - Non-prefamiliarized Commands
 _____ Prefamiliarized Commands

L Linear Treatment
 F Forward Skipping Treatment
 Y Yoked Treatment

Total time. Total time for the instructional program was determined by computing the time elapsed from the first question in the program to the last answer. The means and SDs for total time in minutes are shown in Table 9. A significant effect, $F(2,114)=4.99$, $p<.01$ was found for sequence (see Table 10), where the branching treatments took less time than the linear treatments. The effect for familiarization and the interaction were not significant. A comparison of group means for sequence treatments using Duncan's multiple-range test indicated that the prefamiliarized forward-skipping group and the unfamiliarized yoked group had significantly shorter times ($p<.01$) than the unfamiliarized linear group.

Table 9
Means and SDs for Total Time in Minutes

	Mean	Std. Dev
Prefamiliarized Group		
Linear	69.36	26.82
Forward Skipping	55.00	15.82
Yoked	61.71	24.48
Group Total	62.08	23.24
Non-Prefamiliarized Group		
Linear	73.68	24.05
Forward Skipping	66.89	19.47
Yoked	52.40	12.86
Group Total	64.32	21.02
Total	63.17	22.10

Table 10
 Analysis of Variance
 of Total Time in Minutes

	Sum of Squares	df	Mean Square	F
Main Effects				
PREFAM	159.045	1	159.045	.355
SEQUENCE	4483.264	2	2241.632	4.996*
Interaction				
PREFAM X SEQUENCE	2310.146	2	1155.073	2.575
Residual	51145.333	114	448.643	
Total	58097.789	119	488.217	

* $p < .01$

Efficiency Ratio. The efficiency ratio was computed by dividing the posttest score by the total time taken during the instructional program. Efficiency ratio can be used to compare the effectiveness of instructional treatments in terms of the number of posttest points yielded per minute of instructional time. Means and SDs for efficiency ratio are shown in Table 11. Efficiency ratios greater than 1.00 are possible because this ratio is not a percentage, but simply expresses points per period of time. A significant effect, $F(1,114) = 5.058$, $p < .05$ was found for familiarization, where the prefamiliarized mean was higher than the unfamiliarized mean (see Table 12). No effect was found for sequence, nor was an interaction found.

Table 11
Means and SDs for Efficiency Ratio

	Mean	Std. Dev
Prefamiliarized Group		
Linear	.92	0.48
Forward Skipping	1.00	0.53
Yoked	.93	0.52
Group Total	.95	0.50
Non-Prefamiliarized Group		
Linear	.66	0.41
Forward Skipping	.68	0.50
Yoked	.94	0.40
Group Total	.76	0.45
Total	.86	0.48

Table 12
 Analysis of Variance
 of Efficiency Ratio

	Sum of Squares	df	Mean Square	F
Main Effects				
PREFAM	1.142	1	1.142	5.058*
SEQUENCE	.449	2	.225	0.995
Interaction				
PREFAM X SEQUENCE	.632	2	.316	1.401
Residual	25.735	114	0.226	
Total	27.959	119	0.235	

*p < .05

Per cent of Branch Tests Correct. Branch tests consisted of three test items taken at the beginning of each block of instruction. If these items were all answered correctly, the block of instruction was skipped. Per cent of branch tests correct was computed by dividing the number of branch tests correct by the number of branch tests taken (see Table 13). A highly significant effect, $F(1,114)=262.08$, $p<.01$ was found for familiarization where prefamiliarized groups did better than unfamiliarized groups (see Table 14) but not for sequence, and no significant interaction was found.

Table 13
Means and SDs for Percent of Branch Tests Correct
on the instructional Program

	Mean	Std. Dev
Prefamiliarized Group		
Linear	50.65	18.97
Forward Skipping	54.95	24.67
Yoked	53.85	19.81
Group Total	53.15	21.02
Non-Prefamiliarized Group		
Linear	6.70	8.55
Forward Skipping	2.60	4.86
Yoked	6.55	10.31
Group Total	5.28	8.31
Total	29.22	28.82

Table 14
 Analysis of Variance
 of Percent of Branch Tests Correct

	Sum of Squares	df	Mean Square	F
Main Effects				
PREFAM	68736.533	1	68736.533	263.677*
SEQUENCE	58.217	2	29.108	.112
Interaction				
PREFAM X SEQUENCE	357.617	2	178.808	.686
Residual	29718.000	114	260.684	
Total	98870.366	119	830.843	

* $p < .01$

Attitude Score. The means and SDs for attitude score are shown in Table 15. No significant effects were found for either sequence or familiarization (see Table 16), and no significant interaction was found. The data thus did not support the hypothesis that a familiarization by sequence interaction would be found.

Effectiveness of the Prefamiliarization

The effectiveness of the prefamiliarization procedure was determined by comparing a number of indices for prefamiliarized and non-prefamiliarized groups.

Number of Script Items Presented. The prefamiliarization procedure succeeded in acquainting subjects with parts of the content to be learned. This can be seen from the finding that the prefamiliarized forward skipping subjects were exposed to only approximately 75 per cent of the content (see Table 17; $63.05/84=.75$). The comparison between the prefamiliarized and non-prefamiliarized groups was significant (with the non-prefamiliarized group taking more items) $F(1,114) = 123.499$, $p < .001$, a significant effect was also found for sequence, $F(2,114) = 30.875$, $p < .001$, and the interaction was also significant, $F(2,114) = 30.875$, $p < .001$ (see Table 18).

Table 15
Means and SDs for Attitude Score

	Mean	Std. Dev
Prefamiliarized Group		
Linear	29.25	6.56
Forward Skipping	29.60	5.88
Yoked	32.00	8.20
Group Total	30.28	6.94
Non-Prefamiliarized Group		
Linear	32.35	6.90
Forward Skipping	30.45	7.65
Yoked	30.95	7.92
Group Total	31.25	7.42
Total	30.77	7.17

Table 16
 Analysis of Variance
 of Attitude Score

	Sum of Squares	df	Mean Square	F
Main Effects				
PREFAM	28.033	1	28.033	.536
SEQUENCE	42.117	2	21.058	.403
Interaction				
PREFAM X SEQUENCE	86.317	2	43.158	.825
Residual	5961.000	114	52.289	
Total	6117.467	119	51.407	

Table 17
Means and SDs for Number of Script Items Presented

	Mean	Std. Dev
Prefamiliarized Group		
Linear	84.00	0.00
Forward Skipping	63.05	11.92
Yoked	63.05	11.92
Group Total	70.03	13.81
Non-Prefamiliarized Group		
Linear	84.00	0.00
Forward Skipping	84.00	0.00
Yoked	84.00	0.00
Group Total	84.00	0.00
Total	77.02	11.99

Table 18
 Analysis of Variance
 of Number of Script Items Presented

	Sum of Squares	df	Mean Square	F
Main Effects				
PREFAM	5852.033	1	5852.033	123.499*
SEQUENCE	2926.017	2	1463.008	30.875*
Interaction				
PREFAM X SEQUENCE	2926.017	2	1463.008	30.875*
Residual	5401.900	114	47.385	
Total	17105.967	119	143.748	

*p<.001

Total Posttest Score. The prefamiliarized group achieved more on the posttest than the non-prefamiliarized groups (see Table 3). Out of a total of 73 possible points, the prefamiliarized group earned approximately 70 per cent (50.52/73) compared to 56 per cent (41.10 /73) for the other group. Table 4 indicates that the main effect for familiarization was significant.

Per cent of Branch Tests Correct. Prefamiliarized individuals made fewer errors on branch tests (see Table 14), so that prefamiliarization was effective in yielding branching during the instructional presentation.

Performance on the Instructional Program

Performance on the instructional program was further examined using several additional measures.

Number of Instructional Trials. Number of instructional trials was computed by counting each presentation of an instructional item, included repeated presentations of items not answered correctly. Means and SDs for number of instructional trials are shown in Table 19. A significant effect, $F(1,114) = 31.12$, $p < .001$ was found for familiarization (see Table 20) and a significant effect, $F(2,114) = 7.74$, $p < .001$ was found for sequence. A significant sequence by familiarization interaction, $F(2,114) = 4.96$, $p < .01$ was also found. Duncan's multiple-range test indicates that the yoked prefamiliarized group took the fewest instructional trials.

Table 19
Means and SDs for Number of Instructional Trials

	Mean	Std. Dev
Prefamiliarized Group		
Linear	104.95	11.40
Forward Skipping	83.10	23.49
Yoked	79.95	19.11
Group Total	89.33	21.52
Non-Prefamiliarized Group		
Linear	109.85	21.43
Forward Skipping	114.30	23.79
Yoked	101.60	8.41
Group Total	108.58	19.52
Total	98.96	22.63

Table 20
 Analysis of Variance
 of Number of Instructional Trials

	Sum of Squares	df	Mean Square	F
Main Effects				
PREFAM	11116.875	1	11116.875	31.120**
SEQUENCE	5531.817	2	2765.908	7.743**
Interaction				
PREFAM X SEQUENCE	3544.850	2	1772.425	4.962*
Residual	40723.250	114	357.221	
Total	60916.792	119	511.906	

* $p < .01$

** $p < .001$

Mastery Level. Mastery level was computed by dividing the number of instructional items answered correctly by the number of script items presented (see Table 21). Since different groups took different amounts of instruction, this measure facilitated comparisons between groups because it could be expressed as a ratio or percentage. No effects were found for sequence or familiarization (see Table 22) nor was an interaction found.

Table 21

Means and SDs for Mastery Level

	Mean	Std.Dev
Prefamiliarized Group		
Linear	.95	.040
Forward Skipping	.93	.060
Yoked	.92	.046
Group Total	.93	.050
Non-Prefamiliarized Group		
Linear	.92	.069
Forward Skipping	.92	.072
Yoked	.95	.039
Group Total	.93	.063
Total	.93	.056

Table 22
 Analysis of Variance
 of Mastery Level

	Sum of		Mean	
	Squares	df	Square	F
Main Effects				
PREFAM	0.001	1	0.001	0.210
SEQUENCE	0.005	2	0.002	0.792
Interaction				
PREFAM X SEQUENCE	0.014	2	0.007	2.208
Residual	0.359	114	0.003	
Total	0.379	119	0.003	

CHAPTER V

DISCUSSION

The major hypothesis of this study was of an interaction between prefamiliarization and instructional sequence on achievement, time spent on the instructional program, and on attitude.

Prefamiliarized subjects who took the branching sequence were expected to have a higher level of achievement by virtue of the prefamiliarization. Those who took the linear sequence were expected to do a little less well because of the redundancy or unnecessary support provided. Yoked subjects were expected to do somewhat less well also because the yoked sequence was not necessarily fitted to their learning needs. On the other hand, subjects who were not familiarized were all expected to achieve about the same on the posttest regardless of the sequence they were given, since they would not be able to answer the branch tests correctly and thus would all have roughly the same exposure to the entire instructional presentation.

The data indicate that the hypothesized interactions were not obtained. Prefamiliarized subjects who took the linear sequence did best, while those who took the forward skipping and yoked sequences achieved equally, but not as well as the linear group. The pattern of means for unfamiliarized subjects conformed to expectations except for the yoked group, who scored

almost as well as the prefamiliarized branching subjects.

It was further hypothesized that prefamiliarized subjects would make fewer program errors than those who were not familiarized. The data for error rate do not confirm this, since no differences were found between groups for errors made during the instructional program.

For the prefamiliarized subjects it was expected that those who took the forward skipping sequence would take less time since they would skip portions of the instruction. Unfamiliarized subjects were expected to take about the same time to cover the instruction no matter which sequence they received, since they were not expected to do much skipping and most of them would be taking essentially the same items. Those who took the linear sequence would take more time because of the greater number of items to be covered, while the yoked subjects were expected to take more time because the yoked sequence would be more confusing for them to follow. The interaction was not significant. The data do show, however, that the expected pattern was confirmed except for the unfamiliarized yoked group, who performed as well as the prefamiliarized branching group.

It was also hypothesized that for the linear treatment, familiarized subjects would have less positive attitudes toward the instruction than would unfamiliarized subjects, because familiarized subjects would be getting more support than necessary and they would ~~be~~ become bored or inattentive. The data, however, indicate no significant difference between treatments, with subjects' attitudes remaining consistently positive. Previous

similar findings (Beane, 1965; Brown, 1970) suggest that this outcome may be largely due to subjects' reaction to the novelty of the computer-based instructional medium.

Learning in the Instructional Program

Though the rate of mastery was high in the instructional program (93 per cent mastery, with no significant differences between groups), the relatively low total posttest scores (the mean score for the prefamiliarized group was 50.52 out of a possible 73 points, or 69 per cent while the mean score for the nonfamiliarized group was 41.10, or 56 per cent) show that not much was retained by many of the learners. Ross, et al (note 12) had a similar finding, where it seemed that "in the absence of clear directives indicating 'how much' learning is required, students might feel inclined to study only to the point at which they believe that they can reach criterion on unit tests. A successful performance on such immediate retention measures, however, does not guarantee that the material has been well learned" (p. 14). The mastery criteria in the instructional program apparently did not provide all the exposure required for those who needed it to ensure retention of the lesson material on the posttest.

Total posttest achievement can be conceptualized in terms of two components, corresponding to the scores for the prefamiliarized and the non-prefamiliarized subsets of commands. The first subset reflects the effect of prefamiliarization; the second reflects the differentiation due to branching strategy

employed. While the prefamiliarized subset reflected more closely the interactions generally expected, the non-prefamiliarized subset reflected no such differentiation at all.

Comparison of total posttest scores for familiarized and unfamiliarized groups suggests that total posttest achievement was possibly related to the amount of exposure subjects had to the instructional materials. Duncan's multiple-range test for total posttest score data indicated that the linear prefamiliarized group, with the most exposure to the material, also had the highest total posttest scores ($p < .01$). Subjects in this group took every item in the instructional program, and were thus exposed twice to the prefamiliarized commands, once in the prefamiliarization and once more in the instructional program. The branching and yoked prefamiliarized groups had the next highest scores, though these were not significantly different from the linear prefamiliarized group. The branching group was only exposed to the material a second time if the branch tests associated with that material were not answered correctly, and so received about half of the prefamiliarized material two times. The unfamiliarized groups had the least exposure to the subject matter, and they had the lowest total posttest scores. This was similar to Campbell's (1963) findings, where achievement also corresponded closely to the amount of exposure subjects had to the instructional material.

A possible reason for the non-significant findings might have been subjects' prior acquaintance with the lesson material. Subjects' branching performance on the instructional program,

however, confirmed the fact that no one had any prior acquaintance with the lesson material. In every instance, those subjects who were not familiarized with the material took all the lesson items because none of the criterion tests for forward skipping were met. While different groups received significantly different amounts of instruction, program acquisition indices indicate the same level of mastery for all groups.

As level of prior familiarity decreased, the level of instructional support (i.e., the adaptation available in the instruction) was expected to have more influence on achievement. Instead, as prior familiarity decreased the adaptive capability of the program diminished to the point where all groups received essentially the same instruction. The support available in the program was insufficient for those subjects who were not pre-familiarized on the content. As was the case in the Ross et al. (note 12) study, retention was very high immediately following instruction but final total posttest scores were much lower, which indicates that although the immediate criteria for instructional mastery were satisfied, the branching strategy did not ensure that enough items were covered for the material to be thoroughly assimilated. More opportunities for the assessment of learning and thus for the differentiation of further learning needs would have been warranted. This could have been carried out in a number of ways, such as giving posttests for each command covered, restating and reviewing the objectives for each command instead of just presenting them at the beginning of the instructional program, or looping back for mastery on each

segment of instruction covering a different command. As a further means of promoting retention of the subject matter, positive feedback should have been provided to reinforce correct responses in the instructional program. In view of the relative uniformity of the instructional presentation in this study, differences on the dependent variables could, obviously, not be expected.

Differentiation of Instructional Support

Branching in the instructional program, while significant, was minimal. The branching group took 63.05 items out of a possible 84 program items, which still amounted to 75 per cent of the total instruction. The branching capability of the program not only provided the minimal support needed to satisfy the mastery criteria in the instruction (which of course is exactly what it was intended to do) but it also provided minimal adaptation in many cases. More branching should have been provided to account for differences in achievement levels. The range of subjects' per cent of branch tests correct (from zero to 82 per cent) indicates that some individuals may have gotten two out of three branch tests correct in many cases, but still entered an instructional presentation with no further opportunity to skip material they already knew. A "finer-grained" forward branching capability should have been built into the instructional program. Because forward skipping was only possible on one level (i.e., there was only one set of branch tests per block of instruction), no further adaptation of instruction was possible once a branch

test was answered incorrectly and an instructional presentation entered. More built-in support--in combination with more opportunities to skip over that support -- may have yielded better differentiation between groups, and presumably might have tested the hypothesis more rigorously.

Posttest Feedback

Another problem with the materials was that the posttest provided feedback by responding to incorrect answers with the message, "The program did not understand this part of your answer."

The provision of this feedback on the posttest made it possible for subjects to distinguish between correct and incorrect responses to posttest items. Because it was not possible to turn off this feedback, the posttest became, in effect, a further treatment which was identical for everyone. This not only made the sum total of the treatment received by all the groups even more uniform but also presumably tended to eradicate any previous differences between groups arising from their performance on the instructional program. From this perspective, the forward skipping prefamiliarized group, for instance, still took 84 per cent (60 instructional items + 73 posttest items/ a total of 157 items = .84) of all the material given everybody else, with more than half of it being in the posttest where the differences between groups may have been obscured.

The possible leveling effect of the posttest feedback is indicated by the fact that branching studies by Silberman, et al

(1961), Roe (1962), Campbell (1963), Beane (1965), and Holland, (1972) all used acquisition measures with some form of built-in feedback, and none of these studies found differences between treatments. These measures were, of course, not formal posttests in the sense intended in the present study. On the other hand, the studies by Coulson, et al (1962) and by Dyer and Kulhavy (1974) which found differences between treatments both used criterion measures which did not involve such feedback. The posttest should be modified so that future research using this program does not encounter this difficulty.

Performance of Yoked Groups

The yoked unfamiliarized group did better than the linear and the branching non-familiarized groups, and almost as well as the prefamiliarized groups on total posttest score, total time, and efficiency ratio. These results were contrary to expectation. For per cent of branch tests correct, non-familiarized scores were not significantly different. This suggests that though they began with no special knowledge which could be reflected in the number of branch tests answered correctly, some other characteristic of the group or some feature of the instructional presentation they were given contributed to their subsequent performance.

The consistent performance of the yoked group contrary to expectation indicates that either these individuals were more apt as a group at this kind of program, or they had more relevant experience beforehand, or that some aspect of the yoked presen-

tation caused them to approach the material in a different manner. Since this group was randomly selected and their performance on the branch tests confirms that they had no prior acquaintance with the subject matter, the most likely possibilities are either that this group by chance had some other related set of skills which was not accounted for, or that the yoked treatment called some different strategy into play which reduced the expected loss in achievement for the group. This latter possibility might be similar to the findings of Ross, et al (note 12) who found an unexpectedly high efficiency ratio for a group of subjects whose instructional prescriptions were mismatched relative to their pretest scores. The loss in achievement for this group was smaller than the savings in time realized with the particular treatment they were given, leading to the unexpected efficiency data.

Implications for the ATIs

An ATI approach is both a heuristically fruitful and a practically useful way of analyzing learning. Prior familiarity has been identified as a useful means for organizing and defining a conceptual basis for investigating attribute-treatment interactions, and there already exists a body of empirical support for the concept that prior familiarity and instructional support are systematically inversely related so that for a given level of achievement, instructional support makes less difference as prior familiarity increases (Tobias, 1973, 1976; Deutsch and Tobias, note 3). Although problems may be encountered in measuring and

generalizing observed interactions, the concept is being refined and a more complete understanding is evolving of what relationships may be of practical value for educational applications. The manner in which these relationships must be defined will be understood more clearly as the body of research in this area increases.

The findings of Ross, et al (note 12), Pascarella (1978), and Tobias's work (1976) indicate that the task-specific construct of prior achievement is a more useful measure than aptitude for investigating interactions. Prior achievement can be measured more reliably and replicated in terms of specific educational tasks and subject matter. How does forward skipping interact with prior achievement? A forward skipping treatment removes instructional support when the level of support is more than is necessary for a subject to attain a given level of performance. Forward skipping however cannot add support, it only leaves existing support in place. An inherent problem with this kind of adaptation appears to be that instruction is not usually designed so that it contains a great deal of material which can be skipped over when subjects' performance indicates it is unnecessary or superfluous. As a result, for lower achievement levels instruction which uses forward skipping can very quickly end up being the same for all treatments, with no skipping taking place. As a consequence of the uniform treatment, no interactions then can be observed. The level of instructional support which in the absence of prior achievement might differentiate between treatments is simply not available. For useful generali-

zations to be drawn from the body of empirical evidence which is being accumulated in this area, it appears that the nature of instructional support now also must be more sharply defined so that its essential characteristics can be maintained across different instructional strategies.

Implications for Further Research

Further research is warranted using a finer-grained kind of forward skipping strategy. This would better differentiate the types of learning that can take place once each instructional presentation is entered. In addition, positive feedback should be provided to reinforce correct program responses and the post-test feedback should be eliminated.

Further investigation of the effect of yoked treatments on unfamiliarized subjects also seems warranted. Yoking appeared to provide help of some kind for unfamiliarized subjects, but adversely affected the achievement of subjects who were familiarized with the subject matter. The nature of the activity engaged in by yoked subjects needs further systematic exploration. The study by Ross, et al. (note 12) furthermore showed that learning for Mismatched subjects (a condition similar to yoking in terms of the withdrawal of instructional support) seemed to be quite efficient because the savings in time realized by reducing instructional support were greater than the resultant losses in achievement. While the implications of this phenomenon for educational practice may be quite unacceptable when considered in the context of a conventional classroom setting,

the phenomenon itself bears investigation as a potentially significant variable in learner-controlled instruction.

It can be hypothesized that for subjects whose expectations have not been shaped by prefamiliarization, a yoked treatment provides more of a challenge than some kinds of straightforward branching instruction, and thus yields more effective learning. From this point of view, yoking creates the effect of increased instructional support by drawing on a whole new level of learner participation. More empirical data need to be gathered about the kinds of decisions made by learners under these conditions, and about the critical variables involved in their decision-making.

Further research also seems called for where different levels of prior achievement are included. In this study there were only two levels of familiarization--prefamiliarized, or not prefamiliarized. There were no intermediate levels of prior familiarity. For the subset of RUNOFF commands which were not included in the prefamiliarization materials, total posttest scores for the prefamiliarized and unfamiliarized treatments were essentially the same; but for the subset of commands which were actually prefamiliarized, the prefamiliarization treatment yielded higher achievement and an interaction was found. Investigation of interactions in a context where more levels of prior familiarity are possible might clarify the conditions under which interactions can exist, and presumably would furnish more data to support the observed relationship between prior achievement and instructional support.

Summary

Although prefamiliarization resulted in significant branching, the hypothesized interactions between prefamiliarization and branching treatment were not found. Instead, prefamiliarized groups achieved consistently better on the posttest and on the percentage of branch tests correct, while the branching subjects took less time. Furthermore, the yoked unfamiliarized group performed consistently better than expected.

The absence of the expected interactions appeared to be due to subjects' comparatively poor retention of the material as evidenced by relatively low total posttest scores, and by the lack of both a higher level of instructional support and a "finer-grained" forward skipping strategy to make use of it. This latter condition resulted in the program being unable to differentiate very well between the unfamiliarized groups, who in effect all took the same treatment. The posttest provided feedback which had the effect of creating an even more uniform treatment for everyone, and also eradicating differences due to the previous instruction.

Further investigation is warranted using a more complex forward skipping strategy, with more reinforcement in the instructional program and no feedback in the posttest. The unexpected performance of the yoking group also warrants further exploration. While other research has noted similar effects in passing, a fuller investigation of the causes of the phenomenon would certainly be fruitful.

APPENDIX A
DISTRIBUTION OF SCRIPT ITEMS

Distribution of Script Items

1

8 8 8 8 8 8 8 8 8 8 9 9 9 9 9 9 9 9 9 9 0
 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0

Format	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	
PS																					
RM																					
SP																					
P																					
AP																					
NAP																					
C																					
T																					
S	X	X	X																		
LS				O			X	X						X						X	
LE				O			X	X			X	X		X	X	X					
ELS				O					X	X										X	
F																					
NF																					
TS																					
Keyboard																					

1
 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 2 2
 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1

Format	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	
PS																					
RM																					
SP																					
P																					
AP																					
NAP																					
C																					
T																					
S																					
LS																					
LE	X	X	X																		
ELS				X																	
F				O	O		X		X	X											
NF						O	X	X	X												
TS											O	O	O	X	X	X	X	X			
Keyboard																					

O branch test

X instructional item

Distribution of Posttest Items

0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2
 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0

Format									X										
PS									X									X	
RM							X				X								
SP															X		X		
P														X		X			
AP									X			X					X		
NAP																		X	
C											X								
T						X													
S							X												
LS	X																		
LE		X	X	X															
ELS					X														
F												X							
NF																			
TS																			
Keyboard																			

2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 3 4
 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0

Format																			
PS															X		X		
RM																			
SP									X										
P						X		X											
AP							X												
NAP													X						
C																			
T																			
S																		X	
LS		X												X	X				
LE			X	X							X								
ELS					X				X		X								
F	X							X									X		
NF					X				X						X				
TS					X														
Keyboard																			

0 branch test

X instructional item

Distribution of Posttest Items

4 4 4 4 4 4 4 4 4 4 5 5 5 5 5 5 5 5 5 5 6
 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0

Format	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
PS			X																	
RM								X									X			
SP		X																	X	
P	X																			
AP														X						
NAP				X																
C													X				X	X		
T													X		X					
S		X												X		X				
LS								X												
LE								X	X	X										
ELS													X							
F																				
NF		X			X															
TS		X	X		X								X							
Keyboard																				

O branch test

X instructional item

APPENDIX B
LINEAR SCRIPT

```

%ALGOL
begin external procedure lgout;
integer skiptest,skiprights;
string idname;
skiptest:=0;
skiprights:=0;
%TEACHER CHARLES A. DYER, DEC, BLDG. 1-5/B90, 142 MAIN STREET,
%LANGUAGE ENGLISH
%SWITCH skipversion FALSE
%SGNOSIS
%KEEP
%TEXT page;
RUNOFF Tutorial
=====
This course is for the person who can type a document
on the terminal, but knows nothing about RUNOFF.

Let's make sure you can use the keyboard.
This is like a typewriter keyboard, with
some extra keys added. You may need
the RETURN key and the DELETE key.
%TEXT page;
When you have answered a question, you should press the RETURN
key
so that the program knows you are finished entering information.
Be careful to only press the RETURN key ONCE each time.
%TEXT page;
The DELETE key erases the last character you typed,
as long as you haven't ended the line by pressing RETURN.
%TEXT page;
The keyboard has the numbers 1 through 0, and lower case (small)
and capital letters. You can type answers in either
upper or lower case. Do NOT use the lower case letter "l"
for the number "1".
%TEXT page;
When it asks, "How much do you know about ..." some topic,
the program may ask about something you never learned.
If you have no idea what the answer is,
then type in a question mark, "?".
The program will treat it as a wrong answer and continue.
%TEXT page;
For most answers, the program will say whether you were right
or wrong. When it asks "How much do you know about ..." some
topic,
however, the program will not tell you this.
Type in your ID. Remember to press RETURN afterward.
%QEND
%ALGOL
begin
openfile(2,"");
release(2);
getline;idname:=answer;
output(2,"DSK");
openfile(2,idname);

```

```

end;
%TEXT nopause:=true; page;
If you want to change an answer and have not yet pressed RETURN,
you can erase the last character on the line
by pressing the DELETE (RUBOUT) key.
For example, if you typed EXXPERT and wanted to change it to
EXPERT
you would delete the "T","R", "E","P", and the "X"
by pressing the DELETE key 5 times, then typing PERT back in
again.
%NOEXTRA
%QUESTION TRY1: nopause:=true; page;
Try the DELETE key.
Type in the word EXXPERT,
then delete the XPERT and type the rest of the word,
PERT
back in correctly.
%NEUTRAL EXPERT
Thats how the delete key works.
%NEUTRAL EXXPERT
You didn't get rid of the extra "X"
%EXTRA
%NEUTRAL
%GO TO TRY1
%TEXT page;
RUNOFF is a DECsystem-10 program that enables you to prepare
documents easily.
By inserting RUNOFF commands into your text,
you can format your material with a minimum of effort.
You need not worry about lining up margins,
page numbering, or other formatting considerations.
RUNOFF does all these things for you.
%TEXT page;
When you have finished this lesson, you should be able to:
Set margins and page size
Set line spacing and skip lines
Format paragraphs
Create centered headings and titles
Format lists
Set tab stops
Specify either a ragged right margin or a right margin which is
lined up
%QUESTION TEST1: begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
RUNOFF Commands
=====
What makes a RUNOFF command different from text?
%NOEXTRA
%NEUTRAL . IN COLUMN 1
%ALGOL begin skiprights:=skiprights +1; end;
%NEUTRAL PERIOD IN COLUMN 1
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL PERIOD IN COLUMN ONE

```

```

%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL . IN COLUMN ONE
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL A . IN COLUMN 1
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL A PERIOD IN COLUMN 1
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL A PERIOD IN COLUMN ONE
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL A . IN COLUMN ONE
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT1
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT1
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
When two or more commands are combined on one line,
what character is used to separate commands? Type in the
character.
%NOEXTRA
%NEUTRAL A SEMICOLON
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL SEMICOLON
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL A SEMI COLON
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL SEMI COLON
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ;
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT1
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT1
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
When several commands are combined on one line, what character
marks the
beginning of each command? Just type the character.
%NOEXTRA
%NEUTRAL A PERIOD
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion

```

```

%GOTO TEST2
%IFEND skipversion
%NEUTRAL PERIOD
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST2
%IFEND skipversion
%NEUTRAL .
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST2
%IFEND skipversion
%NEUTRAL DOT
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST2
%IFEND skipversion
%NEUTRAL A DOT
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST2
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT1
%IFEND skipversion
%EXTRA
%NEUTRAL
%GOTO NEXT
%QUESTION SECT1: nopause:=true; page;
RUNOFF Commands and text input
=====
RUNOFF uses TEXT and COMMANDS.
RUNOFF commands tell how to format
the text you enter.
Anything that is not a command is taken as text
and will be part of your finished output.

```

Format of RUNOFF commands

=====

All RUNOFF commands begin with a period "." in column 1 (the first space on the line). Commands can be abbreviated, and several commands can be combined on one line by separating them with a semicolon ";".

Can TEXT input to RUNOFF begin with a period in column 1 (the first space on the line)?

```

%EXTRA
%ORDER

```

%RIGHT NO
 %LACK YES
 Answer yes or no.
 %WRONG
 No, anything with a period in column 1 will be interpreted as a
 command
 by RUNOFF. Everything else will be accepted as text input.
 %TEXT nopause:=true; page;
 Format of text input
 =====
 Text input to RUNOFF is free form.
 Lines can be any length you want.
 Remember, though, that no text line can begin with a period in
 column 1.
 %QUESTION nopause:=true; page;
 With what character do abbreviated RUNOFF commands start? Type
 the character.
 %RIGHT A PERIOD
 %RIGHT .
 %RIGHT DOT
 %RIGHT PERIOD
 %RIGHT A DOT
 %LACK .
 What must be in column one?
 %WRONG
 %QUESTION nopause:=true; page;
 Can more than one RUNOFF command be written on a line? Answer YES
 or NO.
 %RIGHT YES
 %LACK NO
 Answer yes or no.
 %WRONG NO
 %QUESTION nopause:=true; page;
 In order to insert a RUNOFF command into text, you must start a
 new line.
 True or False?
 %RIGHT TRUE
 The command must begin with a period in column 1.
 %LACK FALSE
 Answer either True or False
 %WRONG FALSE
 The command must begin with a period in column 1.
 %QUESTION nopause:=true; page;
 If you want to type in four RUNOFF commands one after another,
 each command
 must start on a new line. Is this true?
 %RIGHT NO
 %RIGHT FALSE
 %LACK YES
 Answer yes or no.
 %WRONG YES
 %QUESTION nopause:=true; page;
 When several RUNOFF commands are typed on one line, in what
 column must the

```

first command begin?
%RIGHT IN COLUMN ONE
%RIGHT COLUMN ONE
%RIGHT IN COLUMN 1
%RIGHT COLUMN 1
%RIGHT IN THE FIRST COLUMN
%RIGHT THE FIRST COLUMN
%RIGHT FIRST COLUMN
%RIGHT ONE
%RIGHT FIRST
%RIGHT 1
%WRONG
%QUESTION TEST2: begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
Setting Page Size
=====
What is the command for setting page size?
Leave out the numbers for a specific page size.
%NOEXTRA
%NEUTRAL .PS
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .PAGE SIZE
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT2
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT2
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
Enter the command to set up a page 60 lines high and 132
characters wide.
%NOEXTRA
%NEUTRAL .PS 60 , 132
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .PAGE SIZE 60 , 132
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT2
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT2
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What is the ABBREVIATED command to set a page size of 45 columns

```

```

and 50 lines?
%NOEXTRA
%NEUTRAL .PS 50 , 45
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST3
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT2
%IFEND skipversion
%EXTRA
%NEUTRAL
%GOTO NEXT
%QUESTION SECT2: nopause:=true; page;
.PAGE SIZE lines , columns or spaces or .PS lines , columns or
spaces
=====
=====

```

This sets page size in lines by columns or spaces .
This is the area your text will occupy on the page.
The default when PAGE SIZE is not specified is
58 lines by 60 spaces.

```

.PAGE SIZE 25,72
for instance, sets page size to 25 lines by 72 columns or spaces.
A page size of 40 lines by 80 columns is specified by
.PS 40,80
How is a page size of 60 lines by 72 spaces specified?
Use the UNABBREVIATED command.
%EXTRA
%RIGHT .PAGE SIZE 60,72
%RIGHT .PAGE SIZE 60 , 72
%LACK .
You left out the period in column 1
This would not be recognized as a RUNOFF command.
%LACK ,
You left out the comma between lines and columns .
%WRONG .PS 60 , 72
Use the UNABBREVIATED command.
%WRONG 60,72
You left out the command.
%WRONG
%QUESTION nopause:=true; page;
How is a page size of 55 lines by 132 columns specified?
%EXTRA
%ORDER
%RIGHT . PAGE SIZE 55 , 132
%RIGHT .PS 55 , 132
%LACK .
You left out the period in column one.
RUNOFF commands have a period in column one.
%LACK ,

```

You left out the comma between lines and cols .

%EXTRA

%WRONG 132 , 55

You should specify lines first, then columns.

%WRONG

Type .PS, then lines , columns .

%WRONG

%QUESTION nopause:=true; page;

How is a page size of 60 lines by 120 spaces or columns defined?

Use the ABBREVIATED command.

%EXTRA

%ORDER

%RIGHT .PS 60 , 120

%LACK .

This is not a RUNOFF command. Put a "." in column one.

%WRONG .PAGE SIZE 60 , 120

Use the ABBREVIATED command.

%WRONG

%QUESTION nopause:=true; page;

Type the ABBREVIATED command to specify a page size of 55 lines and 40 columns.

%EXTRA

%RIGHT . PS 55 , 40

%LACK .

The period is missing from column one.

%EXTRA

%WRONG PAGE SIZE

This is not an abbreviated command.

%WRONG

%QUESTION nopause:=true; page;

In the RUNOFF command

.PS 25,80

What does the 25 stand for, lines or spaces?

%RIGHT 25 LINES

%RIGHT LINES

%RIGHT VERTICAL SPACES

%RIGHT VERTICAL SPACING

%EXTRA

%LACK LINES

We know it's 25,

but 25 of what, lines or columns (spaces)?

%WRONG COLUMNS

Columns is specified by the second number, not the first.

%WRONG

%QUESTION nopause:=true; page;

Using ABBREVIATED commands, set up a page size of 72 columns and 66 lines.

%EXTRA

%RIGHT .PS 66 , 72

%EXTRA

%LACK .

You left out the period

%LACK ,

You left out the comma

```

%LACK PS
You left out the PAGE SIZE command. Remember it should be
ABBREVIATED.
%LACK 66
Number of lines is incorrectly specified.
%LACK 72
Number of columns is incorrectly specified.
%WRONG .PS 72,66
The number of lines comes first.
%WRONG
%QUESTION TEST3: begin skiptest:=skiptest + 1;
end;nopause:=true; page;
How much do you already know about
Setting Right Margin?
=====
What command sets the right margin in column 30?
Include the number in the command.
%NOEXTRA
%NEUTRAL .RM 30
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .RIGHT MARGIN 30
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT3
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT3
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; end;nopause:=true; page;
What ABBREVIATED command sets the right margin in column 25?
%NOEXTRA
%NEUTRAL .RM 25
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT3
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT3
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; end;nopause:=true; page;
How do you set the right margin in column 120?
%NOEXTRA
%NEUTRAL .RM 120
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST4
%IFEND skipversion
%NEUTRAL ?

```

```
%IF skipversion
%GOTO SECT3
%IFEND skipversion
%EXTRA
%NEUTRAL
%QUESTION SECT3: nopause:=true; page;
.RIGHT MARGIN column or .RM column
=====
This sets the right margin to the column specified.
```

```
.RIGHT MARGIN 50
Sets the right margin to column 50.
Write the UNABBREVIATED command to set the right margin to column
80.
%EXTRA
%RIGHT . RIGHT MARGIN 80
%LACK .
This is a RUNOFF command. You need a "." in column one.
%EXTRA
%LACK 80
You didn't specify column 80.
%WRONG .RM 80
Use the UNABBREVIATED command.
%WRONG
%QUESTION nopause:=true; page;
What is the ABBREVIATED command
to set the right margin to 45?
%EXTRA
%RIGHT . RM 45
%LACK .
You left out the period in column 1.
%LACK RM
Remember to abbreviate the command.
%WRONG RIGHT MARGIN 45
%WRONG
%QUESTION nopause:=true; page;
.RM 72
sets the right margin to column 72.
How do you set the right margin to column 120?
%EXTRA
%RIGHT .RIGHT MARGIN 120
%RIGHT .RM 120
%EXTRA
%LACK .
You left out the period. This is not a RUNOFF command.
%WRONG 120
This has nothing to indicate you are setting the right margin.
%WRONG
%QUESTION nopause:=true; page;
What ABBREVIATED command sets the right margin to column 13?
%RIGHT .RM 13
%EXTRA
```

```

%LACK .
You left out the period.
%LACK RM
You left out the ABBREVIATED command for setting the right
margin.
%WRONG
%QUESTION nopause:=true; page;
What ABBREVIATED command sets the right margin to column 20?
%RIGHT .RM 20
%LACK .
You need a period in column 1.
%LACK R M
You have no right margin command.
%LACK 20
You haven't specified column 20.
%WRONG
%QUESTION nopause:=true; page;
What command increases the right margin to 75?
%RIGHT .RIGHT MARGIN 75
%RIGHT .RM 75
%LACK .
This command should begin with a "."
%LACK 75
You must specify column 75 as the column you want.
%WRONG
%QUESTION TEST4: begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
Line Spacing
=====
How do you specify triple spacing?
%NOEXTRA
%NEUTRAL .SPACING 3
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .SP 3
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT4
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT4
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What is the ABBREVIATED command to set line spacing on every
fourth line?
%NOEXTRA
%NEUTRAL .SP 4
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion

```

```

%GOTO SECT4
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT4
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
How is double spacing set?
%NOEXTRA
%NEUTRAL .SPACING 2
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST5
%IFEND skipversion
%NEUTRAL .SP 2
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST5
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT4
%IFEND skipversion
%EXTRA
%NEUTRAL
%GOTO NEXT
%QUESTION SECT4: nopause:=true; page;
.SPACING number or .SP number
=====
Sets vertical spacing between lines.
The default setting is 1, for single spacing.
Spacing can be from 1 to 5.

```

```

.SP 3
gives triple spacing -- text on every third line.
How do you specify text spaced on every fifth line?
Use the UNABBREVIATED command.
%EXTRA
%RIGHT . SPACING 5
%LACK .
For this to be a RUNOFF command, you must have a period in column
one.
%WRONG .SP 5
Don't abbreviate this time.
%EXTRA
%WRONG
%QUESTION nopause:=true; page;
What is the ABBREVIATED command to set double spacing?
%EXTRA
%RIGHT .SP 2

```

```

%EXTRA
%LACK .
You left out the period.
%EXTRA
%LACK 2
How do you know it's double spacing?
%WRONG .S 2
.S is not the abbreviation for SPacing
%WRONG
%QUESTION nopause:=true; page;
What ABBREVIATED command gives triple spacing?
%RIGHT .SP 3
%LACK 3
This is triple spacing. Don't forget the 3.
%LACK .
The command must start with a period in column 1.
%WRONG .SPACING 3
The command should be ABBREVIATED.
%WRONG
%QUESTION nopause:=true; page;
What ABBREVIATED command will give double-spaced text?
%RIGHT .SP 2
%LACK .
You left out the period which makes this a RUNOFF command.
%LACK 2
You didn't specify double spacing.
%WRONG .SPACING 2
The command should be ABBREVIATED.
%WRONG
%QUESTION nopause:=true; page;
After you have changed from single spacing to double spacing,
how do you restore single spacing in your text?
%RIGHT .SPACING 1
%RIGHT .SP 1
%LACK .
You left out the period in column one.
%WRONG
%QUESTION nopause:=true; page;
Is it possible to specify spacing every eighth line?
%RIGHT NO
%LACK YES
Answer yes or no.
%WRONG YES
You can only have spacing up to 5 lines.
%WRONG
%QUESTION TEST5: begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
Paragraph Formatting
=====
How do you specify a new paragraph made by indenting five spaces
and
skipping 3 lines?
%NOEXTRA

```

```

%NEUTRAL .PARAGRAPH 5 , 3
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .P 5 , 3
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT5
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT5
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What is the command for a paragraph made by indenting 7 spaces
and
skipping one line?
%NOEXTRA
%NEUTRAL .P 7 , 1
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .PARAGRAPH 7 , 1
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT5
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT5
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What is the ABBREVIATED command for a paragraph made by skipping
one line
and indenting 10 spaces?
%NOEXTRA
%NEUTRAL .P 10 , 1
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST6
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT5
%IFEND skipversion
%EXTRA
%NEUTRAL
%GOTO NEXT
%QUESTION SECT5: nopause:=true; page;
.PARAGRAPH indent , vertical spacing or .P indent , vertical
spacing
=====

```

=====

Formats a new paragraph.

Indent specifies the number of spaces the first line will be indented.

Vertical spacing is the vertical spacing between paragraphs.

.PARAGRAPH 8,2

Creates a new paragraph by spacing 2 vertical spaces and indenting 8 spaces.

What UNABBREVIATED command will give a new paragraph indented 4 spaces and with 2 vertical spaces?

%EXTRA

%RIGHT . PARAGRAPH 4 , 2

%LACK .

You need a period in column one.

%WRONG .P 4 , 2

Don't abbreviate.

%WRONG

%QUESTION nopause:=true; page;

.P 5,1

Will create a new paragraph indented to column 5, with a vertical spacing of one line.

What ABBREVIATED command will create a new paragraph indented to column 15,

with a vertical spacing of two lines?

%EXTRA

%RIGHT .P 15 , 2

%EXTRA

%LACK .

You forgot the period. It's not a RUNOFF command.

%EXTRA

%LACK 15

The indent should be 15.

%WRONG

%QUESTION nopause:=true; page;

What ABBREVIATED command will create a new paragraph indented to column 8, with 3 vertical spaces?

%RIGHT .P 8 , 3

%LACK .

You forgot the period.

%LACK ,

You forgot the comma.

%LACK 8

You haven't specified the indent of 8 columns.

%LACK 3

You omitted the 3 vertical spaces.

%WRONG

%QUESTION nopause:=true; page;

What does the 3 in

.P 5,3

stand for?

```

%RIGHT LINES
%RIGHT SPACING
%RIGHT VERTICAL SPACING
%RIGHT SPACES
%RIGHT VERTICAL SPACES
%WRONG INDENT
%WRONG
%QUESTION nopause:=true; page;
How would you create a paragraph with vertical spacing of 4
spaces
and indented 8 columns?
%RIGHT .PARAGRAPH 8 , 4
%RIGHT .P 8 , 4
%LACK .
You need a period in column one.
%LACK P
You left out the paragraph command.
%WRONG
%QUESTION nopause:=true; page;
Type the ABBREVIATED command to create a paragraph with vertical
spacing
of 2 lines and indentation of 4 columns.
%RIGHT .P 4 , 2
%LACK .
You need a period in column 1.
%WRONG
%QUESTION TEST6: begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
Autoparagraph?
=====
What command sets autoparagraph mode?
%NOEXTRA
%NEUTRAL .AP
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .AUTOPARAGRAPH
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT6
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT6
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What ABBREVIATED command turns off autoparagraph mode?
%NOEXTRA
%NEUTRAL .NAP
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion

```

```

%GOTO SECT6
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT6
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What ABBREVIATED command always gives a paragraph
indented 3 columns, with a vertical spacing of 2 lines,
whether or not autoparagraph is set?
%NOEXTRA
%NEUTRAL .P 3 , 2
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST7
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT6
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT6
%IFEND skipversion
%QUESTION SECT6: nopause:=true; page;
.AUTOPARAGRAPH or .AP
=====
Causes a BLANK LINE or any line started by pressing the TAB or
SPACE keys
to begin a new paragraph, the same as a .P command.
.AP will use whatever indent and spacing was set by your last
.PARAGRAPH
command. The default if you haven't specified anything yet
is .P 5,1.
Name one of the keys
which you can press at the beginning of a line
which will give a new paragraph when .AP has been set.
%EXTRA
%RIGHT SPACE
%RIGHT TAB
%RIGHT RETURN
%RIGHT BLANK LINE
%RIGHT NEW LINE
%RIGHT RETURN KEY
%RIGHT TAB KEY
%RIGHT
%WRONG
Spell the name out instead of pressing the key.
%WRONG
%QUESTION nopause:=true; page;
Will TAB in the middle of a line give a new paragraph?

```

%RIGHT NO
 %LACK YES
 Answer yes or no.
 %WRONG YES
 The TAB has to be at the beginning of the line.
 %WRONG
 %QUESTION nopause:=true; page;
 What UNABBREVIATED command do you type for a SPACE at the
 beginning of a line
 to give a new paragraph?
 %RIGHT .AUTOPARAGRAPH
 %LACK .
 You need a period in column one.
 %WRONG
 %TEXT nopause:=true; page;
 .NOAUTOPARAGRAPH or .NAP
 =====
 Turns off autoparagraph mode. A blank line, a tab or a blank
 space
 at the beginning of a line will no longer start a new paragraph.
 Of course, the .P command will always start a new paragraph.
 %QUESTION nopause:=true; page;
 What ABBREVIATED command turns off autoparagraph mode?
 %RIGHT .NAP
 %LACK .
 This needs a period in column 1.
 %WRONG
 %QUESTION nopause:=true; page;
 What ABBREVIATED command will still give a new paragraph even
 when
 autoparagraph mode is turned off? Leave out the numbers for
 indent and spacing.
 %RIGHT .P
 %LACK .
 You left out the period in column one.
 %WRONG
 %QUESTION nopause:=true; page;
 If you make tables with rows and columns, where the columns are
 set using
 tab stops, you should disable autoparagraph mode.
 What do you type to turn off autoparagraph?
 %RIGHT .NOAUTOPARAGRAPH
 %RIGHT .NAP
 %LACK .
 You left out the period in column one.
 %WRONG
 %QUESTION nopause:=true; page;
 What ABBREVIATED command do you type when you want the
 convenience
 of starting a new paragraph by simply typing a TAB at the
 beginning
 of a new line?
 %RIGHT .AP
 %WRONG

```

%QUESTION TEST7:  begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
Centered Headings or Captions
=====
What is the ABBREVIATED command to center the heading
PART 1
on a line?
%NOEXTRA
%NEUTRAL .C ; PART 1
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT7
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT7
%IFEND skipversion
%NOEXTRA
%QUESTION  begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What ABBREVIATED command centers the heading
PRACTICE
on a line?
%NOEXTRA
%NEUTRAL .C ; PRACTICE
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT7
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT7
%IFEND skipversion
%QUESTION  begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What command centers the word
VARIATIONS
on a line?
%NOEXTRA
%NEUTRAL .CENTER ; VARIATIONS
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST8
%IFEND skipversion
%NEUTRAL .C ; VARIATIONS
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST8
%IFEND skipversion

```

```

%NEUTRAL ?
%IF skipversion
%GOTO SECT7
%IFEND skipversion
%EXTRA
%NEUTRAL
%GOTO NEXT
%QUESTION SECT7: nopause:=true; page;
.CENTER; text or .C; text
=====
Centers the text.
.CENTER;EFFECTIVE WRITING SKILLS
centers
                                EFFECTIVE WRITING SKILLS
.C;NEW IDEAS FOR 1984
will center
                                NEW IDEAS FOR 1984

```

```

Write the UNABBREVIATED command to center the heading
OUT OF THE HILLS
%EXTRA
%ORDER
%RIGHT . CENTER ; OUT OF THE HILLS
%LACK .
You left out the period.
%LACK ;
You need a semicolon in the command.
%EXTRA
%WRONG
%QUESTION nopause:=true; page;
Write the ABBREVIATED command necessary to center the phrase
WELCOME TO THE LIBRARY
%RIGHT .C; WELCOME TO THE LIBRARY
%LACK . C ;
Check the format of the command you have typed.
%WRONG
%QUESTION nopause:=true; page;
Write the ABBREVIATED command necessary to center the heading,
ABSTRACT
%RIGHT .C ; ABSTRACT
%LACK .
This needs a period in column one.
%LACK ;
You need a semicolon in the Center command.
%WRONG .CENTER;ABSTRACT
This command should be ABBREVIATED.
%WRONG
%QUESTION nopause:=true; page;
What command centers the phrase, TABLE OF CONTENTS?
%RIGHT .CENTER ; TABLE OF CONTENTS
%RIGHT .C ; TABLE OF CONTENTS
%LACK .
You left out the period in column 1.
%WRONG

```

```

%QUESTION nopause:=true; page;
Type the command which centers APPENDIX on a line.
%RIGHT .CENTER ; APPENDIX
%RIGHT .C ; APPENDIX
%LACK .
The period is missing from column one.
%WRONG
%QUESTION nopause:=true; page;
Type the ABBREVIATED command which centers the heading,
DIRECTIONS
%RIGHT .C ; DIRECTIONS
%LACK .
The period is missing from column 1.
%WRONG .CENTER;DIRECTIONS
Abbreviate the command.
%WRONG
%QUESTION TEST8: begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
Titles
=====
How should the title
CHAPTER 1
be specified?
%NOEXTRA
%NEUTRAL .TITLE CHAPTER 1
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .T CHAPTER 1
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT8
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT8
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What ABBREVIATED command sets up the title
READING TECHNIQUES?
%NOEXTRA
%NEUTRAL .T READING TECHNIQUES
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT8
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT8
%IFEND skipversion

```

```

%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What is the ABBREVIATED command to create the title
LANGUAGE HANDBOOK?
%NOEXTRA
%NEUTRAL .T LANGUAGE HANDBOOK
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST9
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT8
%IFEND skipversion
%EXTRA
%NEUTRAL
%GOTO NEXT

```

```

%QUESTION SECT8: nopause:=true; page;

```

```

.TITLE text or .T text
=====

```

Outputs the text across the top of every page after page 1. The rest of the line following the .TITLE command is taken as the title. Unlike the .CENTER command, there is no semicolon ";" in the .TITLE command.

```

.TITLE OPTIMIZATION TECHNIQUES
would give
OPTIMIZATION TECHNIQUES Page no.
for a title, beginning with page 2 of your output.

```

Type the UNABBREVIATED command to create the title

```

LIST OF STATIONS
%EXTRA
%RIGHT . TITLE LIST OF STATIONS
%EXTRA
%WRONG ;

```

Leave out the semicolon.

```

%WRONG

```

```

%TEXT nopause:=true; page;

```

The command

```

.T NOW IS THE TIME

```

places the title

```

NOW IS THE TIME

```

Page no.

at the top of every page after the first page. RUNOFF automatically

numbers the pages for you.

The rest of the line following the .T command is the title.

No other commands can follow a .TITLE command on the same line.

```

%QUESTION nopause:=true; page;

```

What ABBREVIATED command should you type to create the title

```

AROUND THE WORLD

```

```

%RIGHT .T AROUND THE WORLD

```

```

%LACK .

```

You left out the period in column one.
 %LACK T
 You left out the .T command.
 %WRONG
 %QUESTION nopause:=true; page;
 Write the ABBREVIATED command to create a title,
 SEVEN DAYS
 %RIGHT .T SEVEN DAYS
 %LACK .T
 You left out the ABBREVIATED title command.
 %WRONG .TITLE SEVEN DAYS
 You should have ABBREVIATED the title command.
 %WRONG
 %QUESTION nopause:=true; page;
 Is the sequence
 .T Seven days of the week;.s 2;
 a correct title command?
 %RIGHT NO
 %LACK YES
 Just answer yes or no.
 %WRONG YES
 No, after the .T command, everything will be part of the title.
 ";.s 2;" will be part of the title.
 %WRONG
 %QUESTION nopause:=true; page;
 Write the ABBREVIATED command necessary to create the title
 ANNUAL REPORT
 in your RUNOFF output.
 %RIGHT .T ANNUAL REPORT
 %LACK . T ,
 Check the format of the .TITLE command and your punctuation.
 %WRONG
 %QUESTION nopause:=true; page;
 Type the ABBREVIATED command to create the title,STEPS TO TAKE.
 %RIGHT .T STEPS TO TAKE
 %LACK .
 You don't have a period in column one.
 %WRONG .TITLE STEPS TO TAKE
 The command should be ABBREVIATED.
 %WRONG
 %QUESTION TEST9: begin skiptest:=skiptest + 1; nopause:=true;
 end; page;
 How much do you already know about
 Line Skips
 =====
 What is the ABBREVIATED command to skip one line?
 %NOEXTRA
 %NEUTRAL .S 1
 %ALGOL begin skiprights:=skiprights + 1; end;
 %NEUTRAL .S
 %ALGOL begin skiprights:=skiprights + 1; end;
 %NEUTRAL ?
 %IF skipversion
 %GOTO SECT9

```

%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT9
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What is the ABBREVIATED command to skip 3 lines?
%NOEXTRA
%NEUTRAL .S 3
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT9
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT9
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
Without using ABBREVIATED commands, how do you skip four lines?
%NOEXTRA
%NEUTRAL .SKIP 4
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST10
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT9
%IFEND skipversion
%EXTRA
%NEUTRAL
%GOTO NEXT
%QUESTION SECT9: nopause:=true; page;
.SKIP no. or .S no.
=====
Skips the number of lines specified.

.SKIP 2
Skips 2 lines.

What UNABBREVIATED command skips 4 lines?
%EXTRA
%RIGHT . SKIP 4
%LACK .
There is no period in column one.
%LACK S
The .SKIP command is missing.
%WRONG
%QUESTION nopause:=true; page;

```

```

.S 1
Skips one line
.S 5
Skips five lines
What is the ABBREVIATED command to skip 3 lines?
%RIGHT .S 3
%LACK .
Check for the period. You left it out.
%WRONG
%QUESTION nopause:=true; page;
What would you type to skip 6 lines?
%RIGHT . SKIP 6
%RIGHT . S 6
%LACK .
You forgot the "." in column one.
This won't be recognized as a RUNOFF command.
%LACK 6
You haven't specified 6 lines.
%LACK S
You haven't indicated a skip.
%WRONG
%QUESTION nopause:=true; page;
What do you type to skip five lines?
Use the ABBREVIATED command.
%RIGHT .S 5
%LACK .
You need a period in column one.
%LACK 5
You didn't specify five lines
%WRONG
%QUESTION nopause:=true; page;
What do you type to skip nine lines?
%RIGHT .SKIP 9
%RIGHT .S 9
%LACK .
The period is missing from column 1.
%LACK 9
Remember to specify 9 lines
%WRONG
%QUESTION nopause:=true; page;
What command skips two lines?
%RIGHT .SKIP 2
%RIGHT .S 2
%LACK .
The period is missing from column one
%LACK 2
Specify how many lines to skip.
%WRONG
%QUESTION TEST10: begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
Lists
=====
How do you begin a double-spaced list?

```

```

%NOEXTRA
%NEUTRAL .LIST 2
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .LS 2
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT10 .
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT10
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
How do you specify
TWO CUPS FLOUR
as an element in a list?
%NOEXTRA
%NEUTRAL .LIST ELEMENT ; TWO CUPS FLOUR
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .LE ; TWO CUPS FLOUR
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT10
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT10
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
How do you end a list?
%NOEXTRA
%NEUTRAL .END LIST
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST11
%IFEND skipversion
%NEUTRAL .ELS
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST11
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT10
%IFEND skipversion
%EXTRA
%NEUTRAL
%GOTO NEXT

```

%QUESTION SECT10: nopause:=true; page;
 Formatting Lists

=====

RUNOFF can be used to create numbered and indented lists.
 Sub-lists can also be created within lists.
 The .LIST (.LS), .LIST ELEMENT (.LE), and .END LIST (.ELS)
 commands
 are used to format lists.

.LIST number or .LS number

=====

Sets the beginning of an indented list with line spacing
 specified by number .

The indentation for lists is standard.

How do you specify a single-spaced list? Use the UNABBREVIATED
 command.

%EXTRA

%RIGHT .LIST 1

%LACK .

You left out the period in column one.

%LACK 1

You haven't specified single spacing.

%LACK L

You left out the .LIST command.

%WRONG

%QUESTION nopause:=true; page;

What ABBREVIATED command starts a double-spaced list?

%RIGHT .LS 2

%WRONG

%TEXT nopause:=true; page;

.LIST ELEMENT; TEXT or .LE; text

=====

Makes an item in the list. In the finished output, list items
 are indented and are automatically numbered for you.

%QUESTION nopause:=true; page;

How would you specify

ADD TWO TEASPOONS OF SUGAR

as a list element? Use the UNABBREVIATED command.

%RIGHT .LIST ELEMENT;ADD TWO TEASPOONS OF SUGAR

%RIGHT . LIST ELEMENT ; ADD TWO TEASPOONS OF SUGAR

%LACK .

You need a "." in column one.

%LACK ;

You need a semicolon ";" between the LIST ELEMENT command and
 the text.

%WRONG

%QUESTION nopause:=true; page;

Type the ABBREVIATED command to create the list element

MONDAY'S WORK

%RIGHT .LE;MONDAY'S WORK

%RIGHT .LE ; MONDAY ' S WORK

%WRONG

%TEXT nopause:=true; page;

.END LIST or .ELS

=====

terminates the list.

Each list or sublist you create with a .LIST or .LS command must be ended with a matching .ELS or .END LIST command.

```
%QUESTION nopause:=true; page;
```

Here is a list:

```
.LS 1
.LE;RED
.LE;YELLOW
.LE;BLUE
```

Type the UNABBREVIATED command to end this list.

```
%RIGHT .END LIST
```

```
%LACK .
```

You left out the "." in column one.

```
%WRONG
```

```
%QUESTION nopause:=true; page;
```

Here is another list made up of a main list with two sublists:

```
  RUNOFF Input                RUNOFF output
.LS 1
.LE;PRIMARY COLORS           1. PRIMARY COLORS
.LS 1
.LE;RED                       1. RED
.LE;YELLOW                    2. YELLOW
.LE;BLUE                       3. BLUE
.ELS
.LE;SECONDARY COLORS         2. SECONDARY COLORS
.LS 1
.LE;ORANGE                    1. ORANGE
.LE;GREEN                     2. GREEN
.LE;PURPLE                     3. PURPLE
```

On one line, type the two ABBREVIATED commands necessary to end the sublist and also end the main list. Remember to separate the two

commands with a semicolon.

```
%RIGHT .ELS ; . ELS
```

```
%LACK .
```

You left out the "." which makes this a RUNOFF command.

BOTH commands must begin with a period.

```
%LACK ;
```

The two commands should be separated by a ";"

BOTH commands must begin with a period.

```
%WRONG
```

Remember, BOTH commands must begin with a period.

```
%QUESTION nopause:=true; page;
```

```
Create
```

```
SHOES
```

as an element in a list.

```
%RIGHT .LIST ELEMENT ; SHOES
```

```
%RIGHT .LE ; SHOES
```

```
%LACK .
```

The period is missing from column 1.

```
%WRONG
```

```
%QUESTION nopause:=true; page;
```

Type the ABBREVIATED command to make

```

CHECK THE TIME
an element in a list.
%RIGHT .LE ; CHECK THE TIME
%LACK .
You need a period in column one.
%WRONG
%QUESTION nopause:=true; page;
On the next 5 lines type in the ABBREVIATED commands to begin a
double-spaced list, create the elements FRONT, MIDDLE, BACK,
then end the list. Type one command per line.
%RIGHT .LS 2
%WRONG
Start with the command to begin a double-spaced list.
%QUESTION nopause :=true;
Now set up the first list element, FRONT.
%RIGHT .LE;FRONT
%RIGHT .LE ; FRONT
%WRONG
%QUESTION nopause :=true;
Now set up the second list element, MIDDLE.
%RIGHT .LE;MIDDLE
%RIGHT .LE ; MIDDLE
%WRONG
%QUESTION nopause :=true;
Now set up the third list element, BACK.
%RIGHT .LE;BACK
%RIGHT .LE ; BACK
%WRONG
%QUESTION nopause :=true;
Now end the list
%RIGHT .ELS
%WRONG
%QUESTION nopause:=true; page;
On the next 5 lines, type in the ABBREVIATED commands to begin a
single-spaced list, create the elements MAPLE, SPRUCE, POPLAR,
then end the list.
%RIGHT .LS 1
%WRONG
%QUESTION nopause:=true;
Set up the list element, MAPLE.
%RIGHT .LE;MAPLE
%RIGHT .LE ; MAPLE
%WRONG
%QUESTION nopause :=true;
Set up the list element, SPRUCE.
%RIGHT .LE;SPRUCE
%RIGHT .LE ; SPRUCE
%WRONG
%QUESTION nopause:=true;
Set up the list element, POPLAR.
%RIGHT .LE;POPLAR
%RIGHT .LE ; POPLAR
%WRONG
%QUESTION nopause:=true;

```

```

Now end the list.
%RIGHT .ELS
%WRONG
%QUESTION TEST11: begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
Fill Mode
=====
How do you set Fill mode?
%NOEXTRA
%NEUTRAL .FILL
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .F
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT11
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT11
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What ABBREVIATED command specifies that the right margin
is to be lined up by adjusting word spacing?
%NOEXTRA
%NEUTRAL .F
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT11
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT11
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
What ABBREVIATED command turns off fill mode
and gives a ragged right margin?
%NOEXTRA
%NEUTRAL .NF
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST12
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT11
%IFEND skipversion
%EXTRA

```

```
%NEUTRAL
%IF skipversion
%GOTO SECT11
%IFEND skipversion
%QUESTION SECT11: nopause:=true; page;
.FILL or .F
=====
```

Adds extra spaces between words on each line so as to line up the right margin of the text.

How do you specify word spacing so that the right margin is lined up? Use the UNABBREVIATED command.

```
%EXTRA
%RIGHT .FILL
%LACK .
```

For this to be a RUNOFF command, you need a period in column 1.

```
%WRONG
%QUESTION nopause:=true; page;
.NO FILL or .NF
=====
```

Turns off Fill mode, giving a "ragged" or uneven right margin. No extra spaces are added between words, and the word spacing you type in

is what you get back. Lines are still filled up as much as possible, but the right margin is not lined up.

How do you specify an uneven right margin? Use the ABBREVIATED command.

```
%RIGHT .NF
%LACK .
```

You don't have a period in column one.

```
%WRONG
%QUESTION nopause:=true; page;
```

What command gives you exactly the word spacing you type in?

```
%RIGHT .NO FILL
%RIGHT .NF
%LACK .
```

You left out the period in column one.

```
%LACK N
```

Have you specified that you want NO fill?

```
%WRONG
%QUESTION nopause:=true; page;
```

What command results in the words on each line being spaced out so as to line up the right margin?

```
%RIGHT .FILL
%RIGHT .F
%LACK .
```

Without the period in column one, this is not a RUNOFF command.

```
%WRONG
%QUESTION nopause:=true; page;
```

How do you turn off Fill mode so as to get a ragged right margin?

```
%RIGHT .NO FILL
%RIGHT .NF
%LACK .
```

You left out the dot in column one.

```

%WRONG
%QUESTION nopause:=true; page;
What ABBREVIATED command restores Fill mode after it has been
turned off?
%RIGHT .F
%LACK .
You need a period in column 1.
%WRONG
%QUESTION TEST12: begin skiptest:=skiptest + 1; nopause:=true;
end; page;
How much do you already know about
Tab Stops
=====
How do you set a tab stop in column 38?
%NOEXTRA
%NEUTRAL .TAB STOPS 38
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .TS 38
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT12
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT12
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
How do you set tab stops in columns 3, 16, and 40?
%NOEXTRA
%NEUTRAL .TS 3 , 16 , 40
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL .TAB STOPS 3 , 16 , 40
%ALGOL begin skiprights:=skiprights + 1; end;
%NEUTRAL ?
%IF skipversion
%GOTO SECT12
%IFEND skipversion
%EXTRA
%NEUTRAL
%IF skipversion
%GOTO SECT12
%IFEND skipversion
%QUESTION begin skiptest:=skiptest + 1; nopause:=true; end;
page;
If you have tab stops set in column 45 and column 31, what do you
type to
change the tab stop in column 31 to column 20?
%NOEXTRA
%NEUTRAL .TAB STOPS 20 , 45
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion

```

```

%GOTO TEST13
%IFEND skipversion
%NEUTRAL .TS 20 , 45
%ALGOL begin skiprights:=skiprights + 1; end;
%IF skipversion
%GOTO TEST13
%IFEND skipversion
%NEUTRAL ?
%IF skipversion
%GOTO SECT12
%IFEND skipversion
%EXTRA
%NEUTRAL
%GOTO NEXT
%QUESTION SECT12: nopause:=true; page;
Setting tab stops
=====

```

Tab stops can be set wherever you want them.
 For tab settings to work properly,
 .NOFILL (.NF) must be specified and
 autoparagraph should be turned off (.NAP).

```

.TAB STOPS number , number ... or .TS number , number ...
=====

```

Each number you specify must be greater than zero,
 and they must be specified in ASCENDING ORDER.
 Each .TS or .TAB STOPS command clears any previous setting
 before new tab stops are set.

What is the ABBREVIATED command to set tab stops
 in columns 12, 20, 35, and 72?

```

%EXTRA
%RIGHT . TS 12 , 20 , 35 , 72
%LACK .

```

You need a period in column one.

```
%WRONG
```

```
%QUESTION nopause:=true; page;
```

Let's say you have tab stops already set
 in columns 5, 17, 29, and 37.

Type the UNABBREVIATED command to add one more tab stop in column
 55.

```

%RIGHT .TAB STOPS 5,17,29,37,55
%RIGHT .TAB STOPS 5 , 17 , 29 , 37 , 55
%LACK .

```

You have no period in column one.

```
%LACK ,
```

The stops should be separated by commas.

```
%WRONG
```

```
%QUESTION nopause:=true; page;
```

If you have tab stops set in column 2, column 18, column 9, and
 column 28,

how do you move the tab stop from column 28 to column 30?
Remember, tab stops must be specified in ASCENDING ORDER.

%RIGHT .TAB STOPS 2 , 9 , 18 , 30

%RIGHT .TS 2 , 9 , 18 , 30

%WRONG

%QUESTION nopause:=true; page;

How do you set tab stops in columns 8 and 14?

%RIGHT .TAB STOPS 8 , 14

%RIGHT .TS 8 , 14

%LACK .

You left out the period in column one.

%LACK ,

You left out the comma separating the tab positions.

%WRONG

%QUESTION nopause:=true; page;

Set a tab stop in column 10.

%RIGHT .TAB STOPS 10

%RIGHT .TS 10

%LACK .

Put in a period in column 1.

%LACK 10

You didn't specify column 10.

%WRONG

%TEXT TEST13: nopause:=true; page;

This concludes the instruction on RUNOFF.

%FINISH

%ALGOL

selectoutput(2);

write("Tests: ");print(skiptest);write(" "

Correct:");print(skiprights);

newline;

selectoutput(0);

end;

closefile(2);

lgout;

%END

APPENDIX C
LINEAR DIALOGUE

.RUN LINEAR

RUNOFF Tutorial

=====

This course is for the person who can type a document on the terminal, but knows nothing about RUNOFF.

Let's make sure you can use the keyboard. This is like a typewriter keyboard, with some extra keys added. You may need the RETURN key and the DELETE key.

To continue push RETURN.

When you have answered a question, you should press the RETURN key so that the program knows you are finished entering information. Be careful to only press the RETURN key ONCE each time.

To continue push RETURN.

The DELETE key erases the last character you typed, as long as you haven't ended the line by pressing RETURN.

To continue push RETURN.

The keyboard has the numbers 1 through 0, and lower case (small) and capital letters. You can type answers in either upper or lower case. Do NOT use the lower case letter "l" for the number "1".

To continue push RETURN.

When it asks, "How much do you know about ..." some topic, the program may ask about something you never learned. If you have no idea what the answer is, then type in a question mark, "?".

The program will treat it as a wrong answer and continue.

To continue push RETURN.

For most answers, the program will say whether you were right or wrong. When it asks "How much do you know about ..." some topic, however, the program will not tell you this. Type in your ID. Remember to press RETURN afterward.

SAMPLE

If you want to change an answer and have not yet pressed RETURN, you can erase the last character on the line by pressing the DELETE (RUBOUT) key.

For example, if you typed EXXPERT and wanted to change it to EXPERT

you would delete the "T", "R", "E", "P", and the "X" by pressing the DELETE key 5 times, then typing PERT back in again.

Try the DELETE key.
Type in the word EXXPERT,
then delete the XPERT and type the rest of the word,
PERT
back in correctly.
?EXXPERT@TREPX@PERT

That's how the delete key works.
To continue push RETURN.

RUNOFF is a DECsystem-10 program that enables you to prepare documents easily.

By inserting RUNOFF commands into your text, you can format your material with a minimum of effort. You need not worry about lining up margins, page numbering, or other formatting considerations. RUNOFF does all these things for you.

To continue push RETURN.

When you have finished this lesson, you should be able to:

- Set margins and page size
- Set line spacing and skip lines
- Format paragraphs
- Create centered headings and titles
- Format lists
- Set tab stops
- Specify either a ragged right margin or a right margin which is lined up

How much do you already know about
RUNOFF Commands

=====

What makes a RUNOFF command different from text?

?. IN COLUMN 1

When two or more commands are combined on one line, what character is used to separate commands? Type in the character.

?;

When several commands are combined on one line, what character marks the beginning of each command? Just type the character.

?.

RUNOFF Commands and text input

=====

RUNOFF uses TEXT and COMMANDS.

RUNOFF commands tell how to format
the text you enter.

Anything that is not a command is taken as text
and will be part of your finished output.

Format of RUNOFF commands

=====

All RUNOFF commands begin with a period "." in
column 1 (the first space on the line):

Commands can be abbreviated, and several commands can be combined
on one line by separating them with a semicolon ";".

Can TEXT input to RUNOFF begin with a period in
column 1 (the first space on the line)?

?NO

Good for you!

Format of text input

=====

Text input to RUNOFF is free form.

Lines can be any length you want.

Remember, though, that no text line can begin with a period in
column 1.

With what character do abbreviated RUNOFF commands start? Type
the character.

?.

Very good.

Can more than one RUNOFF command be written on a line? Answer YES
or NO.

?YES

Very good.

In order to insert a RUNOFF command into text, you must start a
new line.

True or False?

?TRUE

Right!

The command must begin with a period in column 1.

If you want to type in four RUNOFF commands one after another, each command must start on a new line. Is this true?

?NO

Good!

When several RUNOFF commands are typed on one line, in what column must the first command begin?

?1

You're doing fine.

How much do you already know about
Setting Page Size

=====

What is the command for setting page size?
Leave out the numbers for a specific page size.

? .PS

Enter the command to set up a page 60 lines high and 132 characters wide.

? .PS 60,132

What is the ABBREVIATED command to set a page size of 45 columns and 50 lines?

? .PS 50,45

.PAGE SIZE lines , columns or spaces or .PS lines , columns or spaces

=====

=====

This sets page size in lines by columns or spaces .
This is the area your text will occupy on the page.
The default when PAGE SIZE is not specified is
58 lines by 60 spaces.

.PAGE SIZE 25,72

for instance, sets page size to 25 lines by 72 columns or spaces.
A page size of 40 lines by 80 columns is specified by

.PS 40,80

How is a page size of 60 lines by 72 spaces specified?
Use the UNABBREVIATED command.

? .PAGE SIZE 60,72

Exactly right!

How is a page size of 55 lines by 132 columns specified?

? .PS 55,132

Good!

How is a page size of 60 lines by 120 spaces or columns defined?
Use the ABBREVIATED command.

?PS 60,120

Right!

Type the ABBREVIATED command to specify a page size of
55 lines and 40 columns.

?PS 55,40

Right!

In the RUNOFF command

.PS 25,80

What does the 25 stand for, lines or spaces?

?LINES

Very good.

Using ABBREVIATED commands, set up a page size of 72 columns and
66 lines.

?PS 66,72

Right!

How much do you already know about
Setting Right Margin?

=====

What command sets the right margin in column 30?

Include the number in the command.

?RM 30

What ABBREVIATED command sets the right margin in column 25?

?RM 25

How do you set the right margin in column 120?

?RM 120

.RIGHT MARGIN column or .RM column

=====

This sets the right margin to the column specified.

.RIGHT MARGIN 50

Sets the right margin to column 50.

Write the UNABBREVIATED command to set the right margin to column
80.

? .RIGHT MARGIN 80
Correct.

What is the ABBREVIATED command
to set the right margin to 45?

? .RM 45

Exactly right!

.RM 72

sets the right margin to column 72.

How do you set the right margin to column 120?

? .RM 120

Fine!

What ABBREVIATED command sets the right margin to column 13?

? .RM 13

Very good.

What ABBREVIATED command sets the right margin to column 20?

? .RM 20

Good for you!

What command increases the right margin to 75?

? .RM 75

Right!

How much do you already know about

Line Spacing

=====

How do you specify triple spacing?

? .SP 3

What is the ABBREVIATED command to set line spacing on every
fourth line?

? .SP 4

How is double spacing set?

? .SP 2

.SPACING number or .SP number

=====

Sets vertical spacing between lines.

The default setting is 1, for single spacing.

Spacing can be from 1 to 5.

.SP 3
gives triple spacing -- text on every third line.
How do you specify text spaced on every fifth line?
Use the UNABBREVIATED command.
?.SPACING 3@3@5
Exactly right!

What is the ABBREVIATED command to set double spacing?
?.SP 2
Exactly right!

What ABBREVIATED command gives triple spacing?
?.SP 3
Correct.

What ABBREVIATED command will give double-spaced text?
?.SP 2
Very good.

After you have changed from single spacing to double spacing,
how do you restore single spacing in your text?
?.SP 1
Very good.

Is it possible to specify spacing every eighth line?
?NO
Good!

How much do you already know about
Paragraph Formatting
=====

How do you specify a new paragraph made by indenting five spaces
and
skipping 3 lines?
?.P 5,3

What is the command for a paragraph made by indenting 7 spaces
and
skipping one line?
?.P 7,1

What is the ABBREVIATED command for a paragraph made by skipping
one line
and indenting 10 spaces?

?P 10,1

.PARAGRAPH indent , vertical spacing or .P indent , vertical spacing

=====
=====

Formats a new paragraph.

Indent specifies the number of spaces the first line will be indented.

Vertical spacing is the vertical spacing between paragraphs.

.PARAGRAPH 8,2

Creates a new paragraph by spacing 2 vertical spaces and indenting 8 spaces.

What UNABBREVIATED command will give a new paragraph indented 4 spaces and with 2 vertical spaces?

?PARAGRAPH 4,2

Very good.

.P 5,1

Will create a new paragraph indented to column 5, with a vertical spacing of one line.

What ABBREVIATED command will create a new paragraph indented to column 15, with a vertical spacing of two lines?

?P 15,2

OK!

What ABBREVIATED command will create a new paragraph indented to column 8, with 3 vertical spaces?

?P 8,3

Sure!

What does the 3 in

.P 5,3

stand for?

?VERTICAL SPACES

Fine!

The program was not expecting this part of your answer:

VERTICAL

How would you create a paragraph with vertical spacing of 4 spaces

and indented 8 columns?

?P 8,4

Right!

Type the ABBREVIATED command to create a paragraph with vertical spacing

of 2 lines and indentation of 4 columns.

? .P 4,2

Sure!

How much do you already know about

Autoparagraph?

=====

What command sets autoparagraph mode?

? .AP

What ABBREVIATED command turns off autoparagraph mode?

? .NAP

What ABBREVIATED command always gives a paragraph indented 3 columns, with a vertical spacing of 2 lines, whether or not autoparagraph is set?

? .P 3,2

.AUTOPARAGRAPH or .AP

=====

Causes a BLANK LINE or any line started by pressing the TAB or SPACE keys

to begin a new paragraph, the same as a .P command.

.AP will use whatever indent and spacing was set by your last

.PARAGRAPH

command. The default if you haven't specified anything yet is .P 5,1.

Name one of the keys

which you can press at the beginning of a line

which will give a new paragraph when .AP has been set.

?TAB

Sure!

Will TAB in the middle of a line give a new paragraph?

?NO

Right!

What UNABBREVIATED command do you type for a SPACE at the beginning of a line

to give a new paragraph?

? .AUTOPARAGRAPH

OK!

.NOAUTOPARAGRAPH or .NAP

=====

Turns off autoparagraph mode. A blank line, a tab or a blank space at the beginning of a line will no longer start a new paragraph. Of course, the .P command will always start a new paragraph.

What ABBREVIATED command turns off autoparagraph mode?

?.NAP

Right!

What ABBREVIATED command will still give a new paragraph even when autoparagraph mode is turned off? Leave out the numbers for indent and spacing.

?.P

Right!

If you make tables with rows and columns, where the columns are set using tab stops, you should disable autoparagraph mode. What do you type to turn off autoparagraph?

?.NAP

OK!

What ABBREVIATED command do you type when you want the convenience of starting a new paragraph by simply typing a TAB at the beginning of a new line?

?.AP

Correct.

How much do you already know about
Centered Headings or Captions

=====

What is the ABBREVIATED command to center the heading
PART 1
on a line?

?.C;PART 1

What ABBREVIATED command centers the heading
PRACTICE
on a line?

?.C;PRACTICE

What command centers the word
 VARIATIONS
 on a line?
 ?.C;VARIATIONS

.CENTER; text or .C; text
 =====
 Centers the text.
 .CENTER;EFFECTIVE WRITING SKILLS
 centers
 EFFECTIVE WRITING SKILLS
 .C;NEW IDEAS FOR 1984
 will center
 NEW IDEAS FOR 1984

Write the UNABBREVIATED command to center the heading
 OUT OF THE HILLS
 ?.CENTER;OUT OF THE HILLS
 You're doing fine.

Write the ABBREVIATED command necessary to center the phrase
 WELCOME TO THE LIBRARY
 ?.C;WELCOME TO THE LIBRARY
 Right!

Write the ABBREVIATED command necessary to center the heading,
 ABSTRACT
 ?.C;ABSTRACT
 Right!

What command centers the phrase, TABLE OF CONTENTS?
 ?.C;TABLE OF CONTENTS
 Right!

Type the command which centers APPENDIX on a line.
 ?.C;APPENDIX
 Good for you!

Type the ABBREVIATED command which centers the heading,
 DIRECTIONS
 ?.C;DIRECTIONS
 Exactly right!

How much do you already know about

Titles

=====

How should the title

CHAPTER 1

be specified?

?.T CHAPTER 1

What ABBREVIATED command sets up the title

READING TECHNIQUES?

?.T READING TECHNIQUES

What is the ABBREVIATED command to create the title

LANGUAGE HANDBOOK?

?.T LANGUAGE HANDBOOK

.TITLE text or .T text

=====

Outputs the text across the top of every page after page 1.

The rest of the line following the .TITLE command

is taken as the title.

Unlike the .CENTER command, there is no semicolon ";"

in the .TITLE command.

.TITLE OPTIMIZATION TECHNIQUES

would give

OPTIMIZATION TECHNIQUES

Page no.

for a title, beginning with page 2 of your output.

Type the UNABBREVIATED command to create the title

LIST OF STATIONS

?.TITLE LIST OF STATIONS

Good for you!

The command

.T NOW IS THE TIME

places the title

NOW IS THE TIME

Page no.

at the top of every page after the first page. RUNOFF

automatically

numbers the pages for you.

The rest of the line following the .T command is the title.

No other commands can follow a .TITLE command on the same line.

What ABBREVIATED command should you type to create the title

AROUND THE WORLD

?.T AROUND THE WORLD

Right!

Write the ABBREVIATED command to create a title,
SEVEN DAYS,
?.T SEVEN DAYS
Right!

Is the sequence
.T Seven days of the week;.s 2;
a correct title command?
?NO
Correct.

Write the ABBREVIATED command necessary to create the title
ANNUAL REPORT
in your RUNOFF output.
?.T ANNUAL REPORT
Very good.

Type the ABBREVIATED command to create the title, STEPS TO TAKE.
?.T STEPS TO TAKE
OK!

How much do you already know about
Line Skips
=====

What is the ABBREVIATED command to skip one line?
?.S 1

What is the ABBREVIATED command to skip 3 lines?
?.S 3

Without using ABBREVIATED commands, how do you skip four lines?
?.SKIP 4

.SKIP no. or .S no.
=====

Skips the number of lines specified.

.SKIP 2
Skips 2 lines.

What UNABBREVIATED command skips 4 lines?
?.SKIP 4
OK!

.S 1
Skips one line
.S 5
Skips five lines
What is the ABBREVIATED command to skip 3 lines?
?.S 3
Fine!

What would you type to skip 6 lines?
?.S 6
Good for you!

What do you type to skip five lines?
Use the ABBREVIATED command.
?.S 5
Exactly right!

What do you type to skip nine lines?
?.S 9
You're doing fine.

What command skips two lines?
?.S 2
Right!

How much do you already know about
Lists
=====
How do you begin a double-spaced list?
?.LS 2

How do you specify
TWO CUPS FLOUR
as an element in a list?
?.LE;TWO CUPS FLOUR

How do you end a list?
?@\$@.ELS

Formatting Lists
=====

RUNOFF can be used to create numbered and indented lists.
Sub-lists can also be created within lists.
The .LIST (.LS), .LIST ELEMENT (.LE), and .END LIST (.ELS)
commands
are used to format lists.

`.LIST number or .LS number`
 =====

Sets the beginning of an indented list with line spacing specified by number .

The indentation for lists is standard.

How do you specify a single-spaced list? Use the UNABBREVIATED command.

?`.LIST 1`

Good for you!

What ABBREVIATED command starts a double-spaced list?

?`.LS 2`

Good!

`.LIST ELEMENT; TEXT or .LE; text`
 =====

Makes an item in the list. In the finished output, list items are indented and are automatically numbered for you.

How would you specify

ADD TWO TEASPOONS OF SUGAR

as a list element? Use the UNABBREVIATED command.

?`.LIST ELEMENT;ADD TWO TEASPOONS OF SUGAR`

Correct.

Type the ABBREVIATED command to create the list element

MONDAY'S WORK

?`.LE;MONDAY'S WORK`

Good!

`.END LIST or .ELS`
 =====

terminates the list.

Each list or sublist you create with a `.LIST` or `.LS` command must be ended with a matching `.ELS` or `.END LIST` command.

Here is a list:

`.LS 1`

`.LE;RED`

`.LE;YELLOW`

`.LE;BLUE`

Type the UNABBREVIATED command to end this list.

?`.ELS`

Wrong!

Try again.

Here is a list:

.LS 1

.LE;RED

.LE;YELLOW

.LE;BLUE

Type the UNABBREVIATED command to end this list.

?.END LIST

You're making progress.

Here is another list made up of a main list with two sublists:

RUNOFF Input

RUNOFF output

.LS 1

.LE;PRIMARY COLORS

1. PRIMARY COLORS

.LS 1

.LE;RED

1. RED

.LE;YELLOW

2. YELLOW

.LE;BLUE

3. BLUE

.ELS

.LE;SECONDARY COLORS

2. SECONDARY COLORS

.LS 1

.LE;ORANGE

1. ORANGE

.LE;GREEN

2. GREEN

.LE;PURPLE

3. PURPLE

On one line, type the two ABBREVIATED commands necessary to end the sublist and also end the main list. Remember to separate the two

commands with a semicolon.

?.ELS;.ELS

Very good.

Create

SHOES

as an element in a list.

?.LE;SHOES

Exactly right!

Type the ABBREVIATED command to make

CHECK THE TIME

an element in a list.

?.LE;CHECK THE TIME

Very good.

On the next 5 lines type in the ABBREVIATED commands to begin a double-spaced list, create the elements FRONT, MIDDLE, BACK, then end the list. Type one command per line.

?.LS 2

Fine!

Now set up the first list element, FRONT.

?.LE;FRONT

Correct.

Now set up the second list element, MIDDLE.

?LE;MIDDLE

You're doing fine.

Now set up the third list element, BACK.

?LE;BACK

Fine!

Now end the list

?ELS

Sure!

On the next 5 lines, type in the ABBREVIATED commands to begin a single-spaced list, create the elements MAPLE, SPRUCE, POPLAR, then end the list.

?LS 1

Fine!

Set up the list element, MAPLE.

?LE;MAPLE

Sure!

Set up the list element, SPRUCE.

?LE;SPRUCE

OK!

Set up the list element, POPLAR.

?LE;POPLAR

Good for you!

Now end the list.

?ELS

Good!

How much do you already know about

Fill Mode

=====

How do you set Fill mode?

?F

What ABBREVIATED command specifies that the right margin is to be lined up by adjusting word spacing?

?F

What ABBREVIATED command turns off fill mode and gives a ragged right margin?

?NF

`.FILL` or `.F`

=====

Adds extra spaces between words on each line so as to line up the right margin of the text.

How do you specify word spacing so that the right margin is lined up? Use the `UNABBREVIATED` command.

`?.FILL`

Exactly right!

`.NO FILL` or `.NF`

=====

Turns off Fill mode, giving a "ragged" or uneven right margin. No extra spaces are added between words, and the word spacing you type in

is what you get back. Lines are still filled up as much as possible, but the right margin is not lined up.

How do you specify an uneven right margin? Use the `ABBREVIATED` command.

`?.NF`

Right!

What command gives you exactly the word spacing you type in?

`?.NF`

Good!

What command results in the words on each line being spaced out so as to line up the right margin?

`?.F`

Good!

How do you turn off Fill mode so as to get a ragged right margin?

`?.NF`

Correct.

What `ABBREVIATED` command restores Fill mode after it has been turned off?

`?.F`

Exactly right!

How much do you already know about
Tab Stops

=====

How do you set a tab stop in column 38?

`?.TS 38`

How do you set tab stops in columns 3, 16, and 40?

?TS 3,16,40

If you have tab stops set in column 45 and column 31, what do you type to

change the tab stop in column 31 to column 20?

?TS 20,45

Setting tab stops

=====

Tab stops can be set wherever you want them.

For tab settings to work properly,

.NOFILL (.NF) must be specified and

autoparagraph should be turned off (.NAP).

.TAB STOPS number , number ... or .TS number , number ...

=====

Each number you specify must be greater than zero,

and they must be specified in ASCENDING ORDER.

Each .TS or .TAB STOPS command clears any previous setting

before new tab stops are set.

What is the ABBREVIATED command to set tab stops
in columns 12, 20, 35, and 72?

?TS 12, 20, 35, 72

Exactly right!

Let's say you have tab stops already set

in columns 5, 17, 29, and 37.

Type the UNABBREVIATED command to add one more tab stop in column
55.

?TAB STOPS 5,17,29,37,55

Sure!

If you have tab stops set in column 2, column 18, column 9, and
column 28,

how do you move the tab stop from column 28 to column 30?

Remember, tab stops must be specified in ASCENDING ORDER.

?TS 2,9,18,30

Correct.

How do you set tab stops in columns 8 and 14?

?TS 8, 14

Exactly right!

Set a tab stop in column 10.

?TS 10
Very good.

This concludes the instruction on RUNOFF.

End of lesson "LINEAR".

You have answered 84 questions, and you gave the right answer
84 times.

On 83 questions your answer was right the first time you got the
question.

To continue push RETURN.

APPENDIX D

POSTTEST SCRIPT

```

%ALGOL
begin external procedure lgout;
string idname;
string inter;
string prerun, preterm;
%TEACHER CHARLES A. DYER
%LANGUAGE ENGLISH
%SGNOSIS
%KEEP
%TEXT
Posttest
=====
Take as much time as you need for this test.
READ EACH QUESTION THROUGH before you start to answer it.
Some answers require that you type several commands.
Unless you are told to do otherwise,
type each command on a SEPARATE LINE.
Be careful to type the commands in the order specified by the
question.
When you have typed in some answers, you may get a response which
says, "The computer did not understand your answer,"
or, "The program was not expecting this part of your answer."
DO NOT repeat your answer, but KEEP GOING to the next
answer or the next question.
Now, type in your ID.
%QEND
%ALGOL
begin
openfile (2,"");
release (2);
getline; idname:=answer;
inter:=copy(idname,1,6);
idname:=concat(inter, ".TST");
output (2,"DSK");
openfile (2,idname);
end;
%ORDER
%NOEXTRA
%QUESTION AD1: nopause := true; page;
Did you know RUNOFF before the instruction you just took?
Answer YES or NO.
%NEUTRAL YES
%ALGOL begin prerun:="YES"; end;
%NEUTRAL NO
%ALGOL begin prerun:="NO"; end;
%EXTRA
%NEUTRAL
Answer just YES or NO.
%GOTO AD1
%QUESTION AD2: nopause:=true; page;
Have you ever used a terminal before this instruction?
Answer YES or NO.
%NOEXTRA
%NEUTRAL YES

```

```

%ALGOL begin preterm:="YES"; end;
%NEUTRAL NO
%ALGOL begin preterm:="NO"; end;
%EXTRA
%NEUTRAL
Answer just YES or NO.
%GOTO ADR2
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION page; page;
Using a separate line for each command,
Create a single-spaced list,
put in the three days of the week,
SUNDAY MONDAY TUESDAY as items,
then end the list.
Use ABBREVIATED commands.
%NEUTRAL .LS 1
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue with the list item SUNDAY
%NEUTRAL .LE ; SUNDAY
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue with the list item MONDAY
%NEUTRAL .LE ; MONDAY
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue with the list item TUESDAY
%NEUTRAL .LE ; TUESDAY
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... end the list
%NEUTRAL .ELS
%ALGOL begin score := score +1; latescore := latescore + 1; end;

```

```

%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On separate lines, using abbreviated commands
set up a title, OUTLINE FOR PROGRESS
set the right margin in column 62,
then skip four lines.
%NEUTRAL .T OUTLINE FOR PROGRESS
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... set the right margin in column 62
%NEUTRAL .RM 62
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... skip four lines
%NEUTRAL .S 4
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
What character is used to separate RUNOFF commands on the same
line?
Type the character.
%NEUTRAL ;
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL A SEMICOLON
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL SEMICOLON
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL A SEMI COLON
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL SEMI COLON
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;

```

```

%QUESTION nopause := true; page;
On separate lines using abbreviated commands
Set up a page 40 columns (spaces) wide and 25 lines high,
set autoparagraph mode,
and create the centered heading, FOR SALE.
%NEUTRAL .PS 25 , 40
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... set autoparagraph mode next
%NEUTRAL .AP
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... create the centered heading FOR SALE
%NEUTRAL .C ; FOR SALE
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
What abbreviated command sets the right margin in column 50?
%NEUTRAL .RM 50
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On separate lines
List the abbreviated commands to restore fill mode,
set autoparagraph mode,
then define paragraph formatting to be 15 spaces indentation
and 2 lines of vertical spacing.
%NEUTRAL .F
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... set autoparagraph mode

```

```

%NEUTRAL .AP
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue by setting the paragraph format
%NEUTRAL .P 15 , 2
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
What abbreviated command sets triple spacing?
%NEUTRAL .SP 3
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
What abbreviated command sets a paragraph with vertical spacing
of one line
and indentation of five spaces?
%NEUTRAL .P 5 , 1
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
Using abbreviated commands on ONE LINE,
set autoparagraph mode
set up a triple-spaced page
and set page size to 40 columns (spaces) wide and 20 lines high.
%NEUTRAL .AP ; .SP 3 ; .PS 20 , 40
%ALGOL begin score := score +3; latescore := latescore + 3; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
Using abbreviated commands on 6 separate lines,
disable autoparagraph mode
restore fill mode
then set up a single-spaced list
put in the two items

```

```

FIRST ENTRY and SECOND ENTRY
then end the list.
%NEUTRAL .NAP
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Next, restore fill mode
%NEUTRAL .F
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... begin the list
%NEUTRAL .LS 1
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue with the first list item
%NEUTRAL .LE ; FIRST ENTRY
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Next, set up the second list item
%NEUTRAL .LE ; SECOND ENTRY
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... end the list
%NEUTRAL .ELS
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;

```

```

%QUESTION nopause := true; page;
Using abbreviated commands on ONE LINE,
Disable fill mode
and set tab stops in columns 6, 21, and 35.
%NEUTRAL .NF ; .TS 6 , 21 , 35
%ALGOL begin score := score +2; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true; page;
Set up a paragraph indented 3 spaces with vertical spacing of one
line.
%NEUTRAL .P 3 , 1
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
What abbreviated command sets autoparagraph mode?
%NEUTRAL .AP
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
What abbreviated command explicitly specifies that the right
margin
is to be lined up by adjusting word spacing?
%NEUTRAL .F
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On ONE LINE type the abbreviated commands which
set double spacing,
then set up a paragraph indented 7 spaces, with vertical spacing
of 1 line.
%NEUTRAL .SP 2 ; .P 7 , 1
%ALGOL begin score := score +2; latescore := latescore + 2; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;

```

What abbreviated command terminates a list?

```
%NEUTRAL .ELS
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
```

What abbreviated command produces an uneven right margin?

```
%NEUTRAL .NF
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
```

On two successive lines

type the two abbreviated commands to
set up ONCE MORE as an item in a list,
then end the list.

```
%NEUTRAL .LE ; ONCE MORE
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
```

Continue ... end the list

```
%NEUTRAL .ELS
%ALGOL begin score := score +1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
```

```
%ALGOL begin qcount := qcount +1; end;
```

```
%QUESTION nopause := true; page;
```

What abbreviated command turns off autoparagraph mode?

```
%NEUTRAL .NAP
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
```

What abbreviated command starts a single-spaced list?

```
%NEUTRAL .LS 1
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
```

```

%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On ONE LINE, write the abbreviated commands which
Set up a page 35 spaces wide and 45 lines high,
set a ragged right margin,
and start a triple-spaced list.
%NEUTRAL .PS 45 , 35 ; .NF ; .LS 3
%ALGOL begin score := score +3; latescore := latescore + 3; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On two successive lines,
Write the abbreviated commands necessary
to explicitly specify fill mode
and set up a page 55 lines high by 66 spaces wide.
%NEUTRAL .F
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... set up the page size
%NEUTRAL .PS 55 , 66
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true; page;
On two successive lines below using ABBREVIATED commands,
Skip two lines,
and begin a new paragraph indented nine spaces with vertical
spacing of
one line. Use abbreviated commands.
%NEUTRAL .S 2
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... begin the new paragraph
%NEUTRAL .P 9 , 1
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT

```

```

%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On ONE LINE, write the abbreviated commands necessary to
set double spacing,
turn off fill mode,
skip three lines
and set tab stops in column five and in column fifteen.
%NEUTRAL .SP 2 ; .NF ; .S 3 ; .TS 5 , 15
%ALGOL begin score := score +4; latescore := latescore + 4; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
How is a page size of 60 lines by 120 spaces specified?
Use abbreviated commands.
%NEUTRAL .PS 60 , 120
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
How do you set tab stops in columns 50, 35, and 20?
Use abbreviated commands.
%NEUTRAL .TS 20 , 35 , 50
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On 9 separate lines, using abbreviated commands,
turn off autoparagraph mode,
turn off fill mode,
set tab stops in columns 40 and 50,
set the right margin to column 80,
and create the single-spaced list, ITEM1, ITEM2, ITEM3.
%NEUTRAL .NAP
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... turn off fill mode
%NEUTRAL .NF
%ALGOL begin score := score +1; latescore := latescore + 1; end;

```

```

%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... set the tab stops
%NEUTRAL .TS 40 , 50
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... set the right margin
%NEUTRAL .RM 80
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... begin the list
%NEUTRAL .LS 1
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... put in ITEM1
%NEUTRAL .LE ; ITEM1
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... put in the second list item, ITEM2
%NEUTRAL .LE ; ITEM2
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... put in the third list item, ITEM3
%NEUTRAL .LE ; ITEM3
%ALGOL begin score := score +1; latescore := latescore + 1; end;

```

```

%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... end the list
%NEUTRAL .ELS
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On ONE LINE,
type the abbreviated commands to set autoparagraph mode,
set tab stops in every fifth column from column 5 up to column
20,
then center the heading, WHAT TO DO NEXT
%NEUTRAL .AP ; .TS 5 , 10 , 15 , 20 ; .C ; WHAT TO DO NEXT
%ALGOL begin score := score +3; latescore := latescore + 3; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
Type the abbreviated command to set up a title, GUIDE TO HOUSING.
%NEUTRAL .T GUIDE TO HOUSING
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
What abbreviated command skips two lines?
%NEUTRAL .S 2
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On ONE LINE,
set the right margin in column 25,
and set up the title, HOW TO REALLY SUCCEED.
Use abbreviated commands.
%NEUTRAL .RM 25 ; .T HOW TO REALLY SUCCEED
%ALGOL begin score := score +2; latescore := latescore + 2; end;
%NEUTRAL
%GOTO NEXT

```

```

%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
On ONE LINE, skip two vertical spaces
and create the centered heading, SUMMARY.
Use abbreviated commands.
%NEUTRAL .S 2 ; .C ; SUMMARY
%ALGOL begin score := score +2; latescore := latescore + 2; end;
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%ALGOL begin qcount := qcount +1; end;
%QUESTION nopause := true; page;
Using abbreviated commands on two successive lines,
create the centered heading IT MUST BE MAGIC
then set triple spacing.
%NEUTRAL .C ; IT MUST BE MAGIC
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%EXTRA
%NEUTRAL
%GOTO NEXT
%QEND
%NOEXTRA
%QUESTION nopause := true;
Continue ... set triple spacing
%NEUTRAL .SP 3
%ALGOL begin score := score +1; latescore := latescore + 1; end;
%NEUTRAL
%GOTO NEXT
%FINISH
%ALGOL
selectoutput(2);
write("Prev: ");write(prerun);write(" Term: ");write(preterm);
newline;
selectoutput(0);
end;
closefile(2);
lgout;
%END

```

APPENDIX E
POSTTEST DIALOGUE

.RUN POSTST

Posttest

=====

Take as much time as you need for this test.

READ EACH QUESTION THROUGH before you start to answer it.

Some answers require that you type several commands.

Unless you are told to do otherwise,

type each command on a SEPARATE LINE.

Be careful to type the commands in the order specified by the question.

When you have typed in some answers, you may get a response which says, "The computer did not understand your answer,"

or, "The program was not expecting this part of your answer."

DO NOT repeat your answer, but KEEP GOING to the next answer or the next question.

Now, type in your ID.

SAMPLE

Did you know RUNOFF before the instruction you just took?

Answer YES or NO.

?NO

Have you ever used a terminal before this instruction?

Answer YES or NO.

?YES

To continue push RETURN.

Using a separate line for each command,

Create a single-spaced list,

put in the three days of the week,

SUNDAY MONDAY TUESDAY as items,

then end the list.

Use ABBREVIATED commands.

?LS 1

Continue with the list item SUNDAY

?LE;SUNDAY

Continue with the list item MONDAY

?LE;MONDAY

Continue with the list item TUESDAY

?LE;TUESDAY

Continue ... end the list

?ELS

On separate lines, using abbreviated commands
 set up a title, OUTLINE FOR PROGRESS
 set the right margin in column 62,
 then skip four lines.
 ?.T OUTLINE FOR PROGRESS

Continue ... set the right margin in column 62
 ?.RM 62

Continue ... skip four lines
 ?.S 4

What character is used to separate RUNOFF commands on the same
 line?
 Type the character.
 ?;

On separate lines using abbreviated commands
 Set up a page 40 columns (spaces) wide and 25 lines high,
 set autoparagraph mode,
 and create the centered heading, FOR SALE.
 ?THIS IS A MISTAKE
 The program was not expecting this part of your answer:
 THIS IS A MISTAKE

Continue ... set autoparagraph mode next
 ?.AP

Continue ... create the centered heading FOR SALE
 ?.C;FOR SALE

What abbreviated command sets the right margin in column 50?
 ?.RM 50

On separate lines
 List the abbreviated commands to restore fill mode,
 set autoparagraph mode,
 then define paragraph formatting to be 15 spaces indentation
 and 2 lines of vertical spacing.
 ?.F

Continue ... set autoparagraph mode
 ?.AP

Continue by setting the paragraph format
 ?.P 15,2

What abbreviated command sets triple spacing?

? .SP 3

What abbreviated command sets a paragraph with vertical spacing of one line and indentation of five spaces?

? .P5,1

Using abbreviated commands on ONE LINE,
set autoparagraph mode
set up a triple-spaced page
and set page size to 40 columns (spaces) wide and 20 lines high.
?.AP;.SP3;.PS20,40

Using abbreviated commands on 6 separate lines,
disable autoparagraph mode
restore fill mode
then set up a single-spaced list
put in the two items
FIRST ENTRY and SECOND ENTRY
then end the list.
?.NAP

Next, restore fill mode
?.F

Continue ... begin the list
?.LS1

Continue with the first list item
?.LE;FIRST ENTRY

Next, set up the second list item
?.LE;SECOND ENTRY

Continue ... end the list
?.ELS

Using abbreviated commands on ONE LINE,
Disable fill mode
and set tab stops in columns 6, 21, and 35.
?.NF;.TS6,21,35

Set up a paragraph indented 3 spaces with vertical spacing of one line.
?.P3,1

What abbreviated command sets autoparagraph mode?
?.AP

What abbreviated command explicitly specifies that the right margin
is to be lined up by adjusting word spacing?
?.F

On ONE LINE type the abbreviated commands which
set double spacing,
then set up a paragraph indented 7 spaces, with vertical spacing
of 1 line.
?.SP 2;.P7,1

What abbreviated command terminates a list?
?.ELS

What abbreviated command produces an uneven right margin?
?.NF

On two successive lines
type the two abbreviated commands to
set up ONCE MORE as an item in a list,
then end the list.
?.LE;ONCE MORE

Continue ... end the list
?.ELS

What abbreviated command turns off autoparagraph mode?
?.NAP

What abbreviated command starts a single-spaced list?
?.LS1

On ONE LINE, write the abbreviated commands which
Set up a page 35 spaces wide and 45 lines high,
set a ragged right margin,
and start a triple-spaced list.
?.PS45,35;.NF;.LS 3

On two successive lines,
Write the abbreviated commands necessary
to explicitly specify fill mode
and set up a page 55 lines high by 66 spaces wide.
?.F

Continue ... set up the page size
?.PS55,66

On two successive lines below using ABBREVIATED commands,
 Skip two lines,
 and begin a new paragraph indented nine spaces with vertical
 spacing of
 one line. Use abbreviated commands.
 ?.S 2

Continue ... begin the new paragraph
 ?.P9,1

On ONE LINE, write the abbreviated commands necessary to
 set double spacing,
 turn off fill mode,
 skip three lines
 and set tab stops in column five and in column fifteen.
 ?.SP 2;.NF;.S 3;.TS 5,15

How is a page size of 60 lines by 120 spaces specified?
 Use abbreviated commands.
 ?.PS 60,120

How do you set tab stops in columns 50, 35, and 20?
 Use abbreviated commands.
 ?.TS 20,35,50

On 9 separate lines, using abbreviated commands,
 turn off autoparagraph mode,
 turn off fill mode,
 set tab stops in columns 40 and 50,
 set the right margin to column 80,
 and create the single-spaced list, ITEM1, ITEM2, ITEM3.
 ?.NAP

Continue ... turn off fill mode
 ?.NF

Continue ... set the tab stops
 ?.TS 40,50

Continue ... set the right margin
 ?.RM 80

Continue ... begin the list
 ?.LS 1

Continue ... put in ITEM1
 ?.LE;ITEM1

Continue ... put in the second list item, ITEM2
 ?.LE;ITEM2

Continue ... put in the third list item, ITEM3
?.LE;ITEM3

Continue ... end the list
?.ELS

On ONE LINE,
type the abbreviated commands to set autoparagraph mode,
set tab stops in every fifth column from column 5 up to column
20,
then center the heading, WHAT TO DO NEXT
?.AP;.TS 5,15@5@0,15,20;.C;WHAT TO DO NEXT

Type the abbreviated command to set up a title, GUIDE TO HOUSING.
?.T GUIDE TO HOUSING

What abbreviated command skips two lines?
?.S 2

On ONE LINE,
set the right margin in column 25,
and set up the title, HOW TO REALLY SUCCEED.
Use abbreviated commands.
?.RM 25;.T HOW TO REALLY SUCCEED

On ONE LINE, skip two vertical spaces
and create the centered heading, SUMMARY.
Use abbreviated commands.
?.S 2;.C;SUMMARY

Using abbreviated commands on two successive lines,
create the centered heading IT MUST BE MAGIC
then set triple spacing.
?.C;IT MUST BE MAGIC

Continue ... set triple spacing
?.SP 3

End of lesson "POSTST".
You have answered 30 questions, and you gave the right answer
70 times.
On 72 questions your answer was right the first time you got the
question.

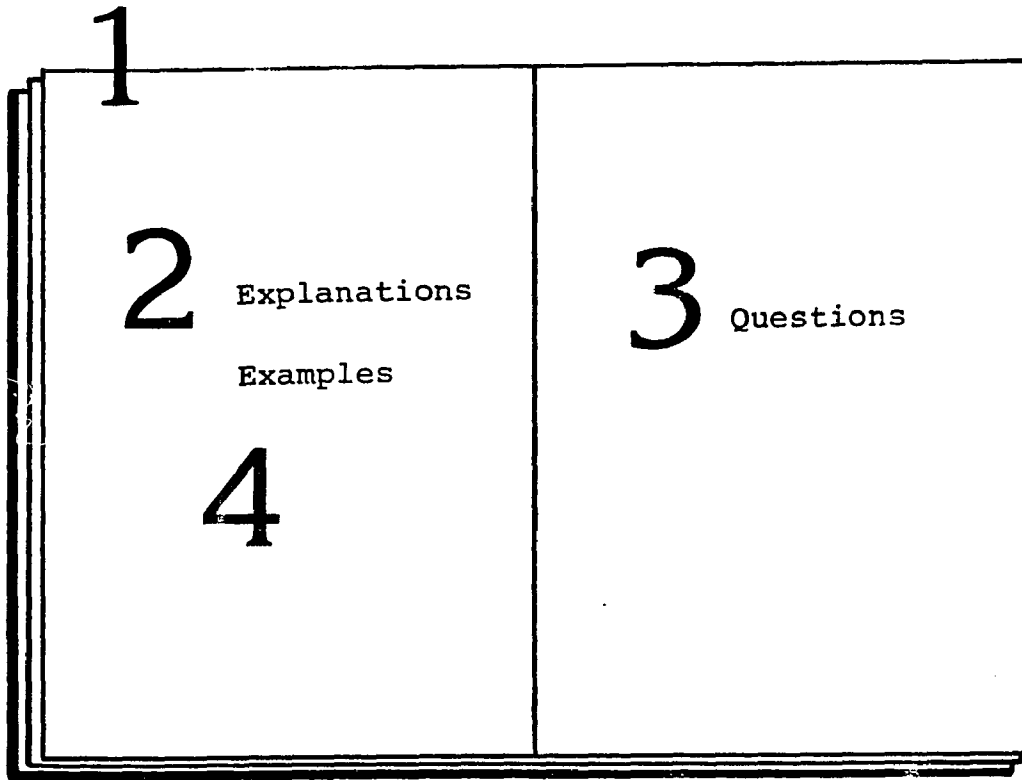
To continue push RETURN.

APPENDIX F
PREFAMILIARIZATION MATERIALS

RUNOFF

Prefamiliarization

Numbers on the diagram are keyed to the items on the facing page.



Prefamiliarization Directions

This booklet will acquaint you with some of the RUNOFF commands you will learn about in the instruction which follows. Read through the booklet at your own pace. There is no time limit for doing this. Follow the steps below as you go over each command.

When you have finished the booklet, take a few minutes to review the material in your mind, then go through the booklet once more. Again, read at your own pace and follow the instructions below. You can look up, check over different pages, or look anywhere in this booklet at any time you wish.

How to Use this Book

- 1 Each double page in this book explains a RUNOFF command, shows three examples of how the command is used, then asks you three questions where you have to use the command. For each command, first briefly scan both pages.
- 2 The first page explains what the command does, and shows the format of the command. Study this information and look at the examples provided so that you can understand how the command works.
- 3 The second page contains three questions you should be able to answer after you understand the explanation on the first page. Read each question and write the answer to that question in the space which follows in the booklet. If you need to figure something out, you can use the other page or the margins for work space.
- 4 When you have finished the three questions, look them over again. Compare your answers to the examples on the first page and check whether your answers are consistent with the examples. If you change your mind about an answer, just change it to what you think the new answer should be.

None of this work will be scored and there is no time limit for going through the book, but you should be sure to write down the answers you decide on.

.P

stands for **PARAGRAPH**

Formats a new paragraph.

The format of the command is

<code>.P indent, vertical spacing</code>
--

The indent is the number of spaces the first line will be indented. Vertical spacing is the spacing between paragraphs.

`.P 5,1`

Begins a paragraph indented 5 spaces with a vertical spacing of 1 line.

`.P 8,2`

Begins a paragraph indented 8 spaces with a vertical spacing of 2 lines.

`.P 3,1`

Begins a paragraph indented 3 spaces with a vertical spacing of 1 line.

What do you write to specify a new paragraph made by skipping two lines and indenting five spaces?

What command gives a paragraph made by skipping one line and indenting eight spaces?

What is the command for a paragraph made by skipping one line and indenting 15 spaces?

.TS

stands for **Tab Stops**

Sets tab stops in the column you specify.

The format of the command is

```
.TS column, column, ...
```

Each column must be greater than zero, and they must be specified in ascending order.

Each .TS command clears the previous setting before setting new tab stops.

```
.TS 5,18,30
```

Sets tab stops at columns 5, 18, and 30.

```
.TS 10
```

Sets a tab stop at column 10.

```
.TS 8, 16, 24, 32
```

Sets tab stops at columns 8, 16, 24, and 32.

How do you set a tab stop in column 33?

Write the command to set tab stops in columns 5, 18, and 42.

If you have tab stops set in column 31 and column 45, how do you change the tab stop in column 31 to column 18? Write the command.

.S

stands for **SKIP**

This skips the number of lines specified.

The format of the command is

<code>.S number</code>

The number n specifies that n lines will be skipped.

`.S 5` skips five lines

`.S 8` skips eight lines.

`.S 3` skips three lines

How do you skip a line?

What is the command to skip two lines?

What command skips 4 lines?

.PS

stands for **Page Size**

This describes the area your text will occupy on the page.

The format of the command is

`.PS lines, columns or spaces`

Lines specifies how high the page of text will be,
and columns (spaces) specifies how wide the page will be.

`.PS 40,60` sets up a page 40 lines high by 60 spaces wide.

`.PS 66, 120` sets up a page 66 lines high by 120 spaces wide.

`.PS 50,80` creates a page 50 lines high by 80 columns (spaces) wide.

What is the command to set a page size 40 lines high
by 72 spaces wide?

Set up a page 45 columns (spaces) wide and 55 lines high.

Set up a page 132 columns wide by 66 lines high.

.SP

stands for **Spacing**

This sets the vertical spacing between lines.

The format of the command is

<code>.SP number</code>

The number n specifies text on every nth line.

`.SP 1` sets single spacing.

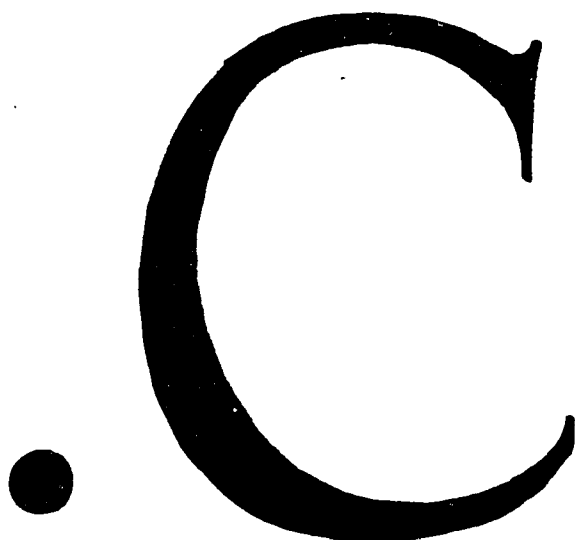
`.SP 2` specifies double spacing.

`.SP 5` sets line spacing on every fifth line.

Set double spacing (text on every second line).

Set triple spacing.

Set line spacing on every fourth line.



stands for **CENTER**

Centers the text which follows

The format of the command is

<code>.C; text</code>

Whatever comes on the rest of the line after the `.C;` is taken as the text to be centered.

`.C; DIRECTIONS`

Centers **DIRECTIONS** on a new line.

`.C; COMMENTS`

Centers **COMMENTS** on a new line.

`.C; ABSTRACT`

Centers **ABSTRACT** on a new line.

Write the command to center the heading
CHAPTER 1
on a line.

What is the command which centers the heading
SUMMARY
on a line?

What command will center the word LANGUAGES on a line?

.RM

stands for **Right Margin**

This sets the right margin to the column specified.

The format of the command is

<code>.RM column</code>

No line of text on the page will go beyond the column specified.

`.RM 80` sets the right margin in column 80

`.RM 120` sets the right margin in column 120

`.RM 45` sets the right margin in column 45.

Write the command to set the right margin in column 80.

What command sets the right margin in column 20?

Set the right margin to column 132.

.F

stands for **FILL**

Adds extra spaces between words on each line so as to line up the right margin of the text (right justifies the text).

The format of the command is

.F

- .F lines up the right margin
- .F sets fill mode
- .F right justifies text by adding extra spaces between words.

What do you write to set file mode?

What command specifies that the right margin is to be lined up by adding spaces?

What command gives right justified text?

APPENDIX G
ATTITUDE QUESTIONNAIRE

#####

QUESTIONNAIRE

#####

Questionnaire

ID: _____ Date: _____

Directions

Each item consists of a statement followed by a scale with several steps marked off. Read the statement. Decide how strongly you agree or disagree with it, then circle one of the steps on the scale which best describes what you think of the statement. The sample question shows how you should do this. Write down the first answer you think of; never mind debating about other possible answers.

Take all the time you need, but do not change any answers once you have written them down. Do not mark between steps on the scale. Instead, pick the step on the scale which is closest to how you feel.

Sample Question

1. Today's weather is ideal.

1-----2-----3-----4
 Strongly Mildly Mildly Strongly
 Agree Agree Disagree Disagree

---o---

1. Time passed rapidly as I was working on the course.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

2. I did not understand what the instruction was supposed to teach me about.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

3. The lesson was too long.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

4. I'd like to learn more about RUNOFF.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

5. Nothing was unnecessarily repeated.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

6. I would have learned more from a regular classroom lesson.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

7. The instructional material was very clear.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

8. The things covered in the lesson were interesting.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

9. The course repeated a lot of things I already knew.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

10. I would be interested in taking more instruction presented on the computer.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

11. There were things left out of the lesson that I thought should have been included.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

12. The purpose of each part of the lesson was clearly explained.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

13. I know RUNOFF well enough to try using it in my work, if I had to.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

14. Not enough questions were asked in the lesson to make sure I had learned anything.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

15. The instruction was presented in small enough steps for me to learn it easily.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

16. There were enough opportunities to try out what was being explained.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

17. I couldn't wait for the course to be done with.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

18. Learning via computer is fun.

1-----	2-----	3-----	4-----
Strongly	Mildly	Mildly	Strongly
Agree	Agree	Disagree	Disagree

19. This presentation was too simple for the level at which I am accustomed to working.

1-----	2-----	3-----	4-----
Strongly Agree	Mildly Agree	Mildly Disagree	Strongly Disagree

20. Before this instruction, I knew nothing about RUNOFF.

1-----	2-----	3-----	4-----
Strongly Agree	Mildly Agree	Mildly Disagree	Strongly Disagree

21. I think the lesson was too short.

1-----	2-----	3-----	4-----
Strongly Agree	Mildly Agree	Mildly Disagree	Strongly Disagree

22. The instruction was boring.

1-----	2-----	3-----	4-----
Strongly Agree	Mildly Agree	Mildly Disagree	Strongly Disagree

XXXXXXXXXXXX

XXXXXXXXXXXX

APPENDIX H

CONSENT FORM, CHECKLIST, INFORMATION SHEET

Information and Consent Form

Date: __/__/__

This study compares the effectiveness of different methods of teaching via Computer Assisted Instruction. Participation is voluntary, and you can withdraw at any time.

At the conclusion of this study, the results will be made available for your information, if you wish.

Your
Name: _____

Phone: _____ Location: _____

Best time to contact: _____

Checklist of Procedures

Name: _____ Phone: _____ Date: _____ Seq _____

1. |__| Consent Form
2. |__| Assign to Cell, ID: _____
3. |__| Information Sheet
4. |__| Prefamiliarization
5. |__| Terminal Session
 - LOGIN,
 - TTY WIDTH 80, FILL 0, LC, NO FORM
 - RUN _____
6. |__| Run POSTST
7. |__| Run DIGEST
8. |__| Attitude Questionnaire
9. |__| Backup of path file
10. |__| Run YOKING, COPY /X/T, Run GNØSIS
 - LOAD _____ .ALG, LGOUT
 - NSAVE
11. |__| Debriefing

Name:-----

Your ID is _ _ _ _ _

General Instructions

This instruction will teach you how to use RUNOFF, a text-formatting program.

If you do not know how to log in to the computer system and start the instructional program, this will be done for you. You will be automatically logged out by the program.

The instructional program will present information and ask you questions based on that information. Think about your answer, then type it in to the terminal. Take as much time as you need.

When you have typed in your response to each item, press the RETURN key on the terminal so that the program knows you are finished entering information. If you don't know an answer, type a question mark, "?" and press RETURN.

Be careful to only press the RETURN key ONCE for each answer.

If you want to change an answer and have not yet pressed the RETURN key, you can erase a character at a time by pressing the DELETE (RUBOUT) key. For example, if you want to erase the last four characters you have just typed, you would press the DELETE key four times.

The terminal keyboard is just like a typewriter keyboard, with a few extra keys added. You will only need the RETURN key, however, and perhaps the DELETE key. You do not need the other keys for this instruction. The terminal keyboard has the numbers 1 through 0, and both lower case (small) and capital letters. This instructional program will take answers in either lower case or capital letters. Do not use the lower case letter "l" for the number "1".

BIBLIOGRAPHY

Reference Notes

1. Barnes, I.D. The effect of learner controlled computer-assisted instruction on performance in multiplication skills. Unpublished doctoral dissertation, University of Southern California, 1970.
2. Berliner, D. C. Aptitude-treatment interactions in two studies of learning from lecture instruction. Paper presented at the annual meeting of the American Educational Research Association, New York, February, 1971.
3. Deutsch, T., and Tobias, S. Prior achievement, anxiety, and instructional method. Paper presented at the annual meeting of the American Psychological Association, Montreal, Sept. 1980.
4. Fredericks, P. S. The effects of locus of control on CAI performance. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, California, April, 1975.
5. Fry, J.P. The interactive relationship between inquisitiveness and student control of instruction. Michigan State University, 1971.
6. Holland, J. G., Hoffman, J. S. and Doran, J. The yoked control for assessing branch effects: Does individualization help? Presented at the annual meeting of the American Educational Research Association, Chicago, April, 1972.

7. Judd, W.A., Bunderson, C.V., & Bessent, C.V. An investigation of the effects of learner control in computer-assisted instruction prerequisite mathematics (MATHS). Technical Report No. 5, Computer-Assisted Instruction Laboratory, The University of Texas at Austin, 1970.
8. Mayer, R. E. Differences in breadth of transfer due to advance organizers and subject control of frame sequencing. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, April, 1976.
9. Milner, S. Learner-controlled computing: A description and rationale. Catholic University of America, Washington, D.C.: 1974.
10. Olivier, W.P. Program sequence by ability interaction of learning a hierarchical task by computer-assisted instruction. Technical Report No. 4, Computer-Assisted Instruction Laboratory, The University of Texas at Austin, 1971.
11. O'Neal, F. Learner control of instruction: Requirements and potentials. ICUE Technical Report No. 2, Brigham Young University, Institute for Computer Uses in Education, August 22, 1973.
12. Ross, S.M., Rakow, E.A., Bush, A.J., and Cervetti, M.J. Instructional adaptation for self-managed learning systems. Paper presented at the annual meeting of the American Educational Research Association, Boston, April 1980.

13. Silberman, H.F., Coulson, J.E., Melaragno, R.J., and Estavan, D.P. Fixed sequence versus branching in a computer-based teaching machine. (Report No. SP-195) Santa Monica: System Development Corporation, 1960.
14. Tobias, S. The effect of creativity, response mode, and subject matter familiarity on achievement of programmed instruction. New York:MSS Educational Publishing Company, 1968.
15. Tobias, S. Research strategy in the effect of individual differences on achievement from programmed instruction. Paper presented at a symposium entitled "Individual differences and instructional methods" at the annual meeting of the American Psychological Association, Washington, D. C., September 1969.
16. Tobias, S. A history of an individualized instructional program of varying familiarity to college students. (Tech. Memo 43) Tallahassee: Florida State University, CAI Center, 1972.
17. Tobias, S. Interaction between achievement and instructional method. Paper presented as part of a symposium on "Achievement, aptitude, arousal: Three approaches to ATI" at the annual meeting of the AERA, Toronto, Ontario, Canada, March 1978.
18. Tobias, S. and Ingber, Z. Achievement treatment interactions in programmed instruction. New York: CUNY, 1975.
19. Tobias, S., and Litwak, D. Adapting instruction to achievement differences. New York: CUNY, 1977.

20. Treffinger, D. J., and Davis, J. K. Beginning notes toward conceptualization of learner-controlled instruction. Paper presented at the 79th annual meeting of the American Psychological Assn., Washington, D. C., Sept., 1971.

References

- Abramson, T., and Kagen, E. Familiarization of content and different response modes to programmed instruction. Journal of Educational Psychology, 1975, 67, 83-88.
- Atkinson, R. C. Computerized instruction and the learning process. American Psychologist, 1968, 23, 225-239.
- Beane, D. G. A comparison of linear and branching techniques of programmed instruction in plane geometry. Journal of Educational research, 1965, 58, 319-326.
- Berliner, D. C., and Cahen, L. S. Trait-treatment interaction and learning. In Review of Research in Education, 1973, 58-94.
- Bohm, C. and Jacopini, G. Flow diagrams, Turing machines and languages with only two formation rules. Communications of the ACM, 1966, 366-371.
- Bracht, G. H. Experimental factors related to aptitude-treatment interactions. Review of Educational Research, 1970, 40, 627-645.
- Brown, J. L. Effects of logical and scrambled sequences in mathematical materials on learning with programmed instruction materials. Journal of Educational Psychology, 1970, 61(1), 41-45.

- Cahen, L. S., and Linn, R. L. Regions of significant criterion differences in aptitude-treatment interaction research. American Educational Research Journal, 1971, 8, 521-530.
- Campbell, V. N. Bypassing as a way of adapting self-instruction to individual differences. Journal of Educational Psychology, 1963, 54, 337-345.
- Campbell, V.N., and Chapman, M.A. Learner control vs. program control of instruction. Psychology in the Schools, 1967, 4(2), 121-130.
- Coulson, J. E., Estavan, D. P., Melaragno, R. J., and Silberman, H. F. Effects of branching in a computer-controlled auto-instructional device. Journal of Applied Psychology, 1962, 46, 389-392.
- Cronbach, L. J. The two disciplines of scientific psychology. American Psychologist, 1957, 12, 671-684.
- Cronbach, L. J. Beyond the two disciplines of scientific psychology. American Psychologist, 1975, 30, 116-127.
- Cronbach, L. J., and Snow, R. E. Individual differences in learning ability as a function of instructional variables. Final Report, U.S. Office of Education Contract No. OEC-4-6-061269-1217, School of Education, Stanford University, 1969.
- Cronbach, L. J., and Snow, R. E. Aptitudes and instructional methods. New York: Irvington Publishers, 1977.
- Crowder, N. A. The arithmetic of computers (vol. 1). Santa Barbara, CA: USI Western Design, 1960.

- Davis, W.K. Student choice of means and ends. NSPI Journal, 1971, 10(1).
- Dyer, J. W., and Kulhavy, R. W. Sequence effects and reading time in programmed learning. Journal of Educational Psychology, 1974, 66(1), 57-61.
- Flexer, R. J., and Flexer, A. S. Programmed reviews of mathematics. New York: Harper and Row, 1967.
- Gagne, R. M., and Brown, L. T. Some factors in the programming of conceptual learning. Journal of Experimental Psychology, 1961, 62, 313-321.
- Grubb, R. E. A study of differential treatments in the study of elementary statistics. Paper presented at the DAVI conference, Portland, Oregon, April 1969.
- Hamilton, N. R. Effects of logical versus random sequencing of items in an autoinstructional program under two conditions of covert response. Journal of Educational Psychology, 1964, 55(5), 258-266.
- Holland, J. G. Variables in adaptive decisions in individualized instruction. Pittsburgh: University of Pittsburgh Learning Research and Development Center, 1975.
- Johnson, P. O., and Neyman, J. Tests of certain linear hypotheses and their application to some educational problems. Statistical Research Memoirs, 1936, 1, 57-93.
- Judd, W. A., O'Neill, H. F., and Spelt, P. F. Individual differences and learner control I: Program development and investigation of control over mnemonics in computer-assisted instruction. Report AFHRL-TR-74-3, Air Force Human Resources

Laboratory, Lowry AFB, Colorado, Technical Training Division; University of Texas at Austin, Computer-Assisted Instruction Lab., July, 1974.(a)

Judd, W. A., O'Neill, H. A., and Spelt, P. F. Individual differences and learner control II: Investigation of control over pictorial mediators in computer-assisted instruction. Report AFHRL-TR-74-30. Air Force Human Resources Laboratory, Lowry AFB, Colorado, Technical Training Division; University of Texas at Austin, Computer-Assisted Instruction Lab., July 1974.(b)

Klopfer, L., Champagne, A., and Pittman, J. Individualized science. Kankakee, ill.:Imperial International Learning, 1972.

Lahey, G. F., Crawford, A. M., and Hurlock, R. E. Learner control of lesson strategy: A model for PLATO IV system lessons. Report No. NPRDC-TR-76-36, Navy Personnel Research and Development Center, San Diego, June 1976.

Levin, G. R., and Baker, B. L. Item scrambling in a self-instructional program. Journal of Educational Psychology, 1963, 54(3), 138-143.

Lindvall, C. M., and Bolvin, J. Programmed instruction in the schools: An application of programming principles in "Individually prescribed Instruction." In Sixty-sixth yearbook of the National Society for the Study of Education, Part II, 1967, 66, 217-254.

Mager, R. F. On the sequencing of instructional content. Psychological Reports, 1961, 9, 405-413.

- Mager, R. F., and McCann, J. Learner-controlled instruction. Palo Alto: Varian Associates, 1961.
- Mayer, R. E. Some conditions of meaningful learning for computer programming: Advance organizers and subject control of frame order. Journal of Educational Psychology, 1976, 68(2) 143-150.
- Newman, S. E. Student vs. instructor design of study method. Journal of Educational Psychology, 1957, 48, 328-333.
- Niedermeyer, F., Brown, J., and Sulzen, B. Learning and varying sequences of ninth-grade mathematics materials. Journal of Experimental Education, 1969, 37(3), 61-66.
- Ott, M.D. Evaluation of methods of instruction and procedures for assigning students to methods. American Journal of Physics, 1976, 44(1), 12-17.
- Ott, M.D., and Macklin, D.B. A trait-treatment interaction in a college physics course. Journal of Research in Science Teaching, 1975, 12(2), 111-119.
- Pascarella, E.T., Interactive effects of prior mathematics preparation and level of instructional support in college calculus. American Educational Research Journal, 1978, 15, 275-285.
- Payne, P. A., Krathwohl, D. R. and Gordon, J. The effect of sequence on programmed instruction. American Educational Research Journal, 1967, 4(2), 125-132.
- Roe, A. A comparison of branching methods for programmed learning. Journal of Educational Research, 1962, 55, 407-416.

- Roe, K. V., Case, H. W., and Roe, A. Scrambled versus ordered sequence in autoinstructional programs. Journal of Educational Psychology, 1962, 53(2), 101-104.
- Salomon, G. Heuristic models for the generation of aptitude-treatment interaction hypotheses. Review of Educational Research, 1972, 42, 327-344.
- Salomon, G. Internalization of filmic schematic operations in interaction with learners' aptitudes. Journal of Educational Psychology, 1974, 66(4), 499-511.
- Silberman, H. F., Melaragno, R. J., Coulson, J. E., and Estavan, D. Fixed sequence vs. branching auto-instructional methods. Journal of Educational Psychology, 1961, 52, 166-172
- Tallmadge, G. K. Relationships between training methods and learner characteristics. Journal of Educational Psychology, 1968, 59, 32-36.
- Tallmadge, G. K., and Shearer, J. W. Relationships among learning styles, instructional methods, and the nature of learning experiences. Journal of Educational Psychology, 1969, 60, 222-230.
- Tallmadge, G. K., and Shearer, J. W. Interactive relationships among learner characteristics, types of learning, instructional methods, and subject matter variables. Journal of Educational Psychology, 1971, 62, 31-38.
- Tobias, S. Effect of creativity, response mode, and subject matter familiarity on achievement from programmed instruction. Journal of Educational Psychology, 1969, 60, 453-460.

- Tobias, S. Review of the response mode issues. Review of Educational Research, 1973, 43, 193-204.(a)
- Tobias, S. Sequence, familiarity, and attribute by treatment interactions in programmed instruction. Journal of Educational Psychology, 1973, 64, 133-141.(b)
- Tobias, S. Distraction, response mode, anxiety, and achievement from CAI. Journal of Educational Psychology, 1973, 65, 233-237.(c)
- Tobias, S. Achievement treatment interactions. Review of Educational Research, 1976, 46(1), 61-74.
- Tobias, S., and Abramson, T. The relationship of anxiety, response mode, and content difficulty to achievement in programmed instruction. Journal of Educational Psychology, 1971, 62, 357-364.
- Tobias, S., and Duchastel, P.C. Behavioral objectives, sequence, and anxiety in CAI. Instructional Science, 1973 (3), 231-242.
- Tobias, S. and Hanlon, R. Attitudes toward instructors, social desirability, and behavioral intentions. Journal of Educational Psychology, 1975, 67, 405-408.
- Trown, E. A., and Leith, G. O. M. Decision rules for teaching strategies in primary schools: Personality-treatment interactions British Journal of Educational Psychology, 1975, 45, 130-140.